

Radiological Investigations of Head Trauma

Introduction:

Cranio cerebral injuries is a common cause of morbidity and mortality among trauma patients. Management of patients vary according to the severity of the injuries, (GCS SCORE).

Some patients need immediate neurosurgical intervention and some require close observation and management in the hospital.

Cranio cerebral injuries which occur with head trauma are

- Skull vault fractures,
- Extra dural haematomas
- Sub dural haematomas
- Intra cranial haemorrhage,
- Sub arachnoid haemorrhage
- Compression of intracranial structures due to haematomas (ventricles, basal ganglia , grey and whitematter)
- Base of the skull fractures involving brainstem
- Vascular injuries

2.1 Imaging Modalities Useful In Head Trauma

Following imaging modalities are useful in the evaluation of head trauma, however the availability of these radiological facilities vary from one hospital to the other, Most of these facilities are available in hospitals which are equipped with facilities for neurosurgery.

Imaging modalities

- Skull Radiography
- Computed Tomography
- Magnetic Resonance Imaging
- Cerebral angiography
- Functional brain imaging (SPECT, PET, Xenon enhanced CT , Functional MRI)
- Trans cranial Doppler

2.3.1 Skull Radiography

Available in all centers. Involves ionizing Radiation,

Skull x-ray postero anterior views (PA view) and lateral views are the standed views, and these two views are adequate,

Findings:

- Calvarial fractures,
- Penetrating injuries
- Radio opaque foreign bodies Ex bullets, sharpnls
- Scalp haematomas which appear as a soft tissue mass in the scalp

Limitations:

Transport of the patient to the Radiology department is time consuming, and this may not be possible if head trauma is associated with cervical cord injuries.

Skull vault fractures are not necessarily associated with intra cranial injury and intracranial injuries are not necessarily associated with skull vault fractures.

2.3.2 Computed Tomography

This facility is available in specilised referral centers. Axial noncontrast scans are performed for acute head trauma. These scans are sensitive in demonstrating all types of acute, sub acute or chronic hematomas regardless of the location, (sub dural, extra dural, subarachnoid, Intraventricular and intracranial haemorrhages).

Extra dural hematomas appear as convex shaped areas of high density and Sub dural hamatomas appear as crescentic shaped high density areas.

These appearance changes with the resolution of the haematoma. Subacute haematomas appear grey and old haematomas appear cystic.

CT demonstrates associated changes in the brain which has a direct impact on the clinical outcome of the patient and management of the patient. These changes include involvement of the ventricles, compression of brainparenchyma and associated skull vault fractures.

Limitations of CT Scanning are:

- Insensitive in detecting small non hemorrhagic haematomas and contusions, particularly adjacent to bone surfaces.
- Insensitive in detecting axonal injuries,
- Inability to demonstrate Hypoxic –ischemic encephalopathy.
- Inadequate demonstration of brain stem injuries
- Exposure to ionizing radiation

As facilities for rapid CT scanning is available in specialized centers which treat head injury patients, routine use of CT scanning is advocated as a screening tool for all head injury patients who require hospital admission , how ever selecton of patients according to the GCS score varies from center to center.

2.3.3. Magnetic Resonance Imaging

Use of Magnetic Resonance Imaging in head trauma is hindered by its;

- Limited availability
- Long imaging times
- Sensitivity to patient motion
- Incompatibility with various medical and life supporting devices
- Relative insensitivity to subarachnoid haemorrhages

MRI is sensitive in detecting

- Sub acute and chronic haematomas
- Small haematomas which are not detected by CT
- Detection of early hypoxic ischemic encephalopathy
- Detection of infarcts associated with head injury
- MRA (MR angiography) is useful in detecting thromboses, Pseudoaneurysms or dissection.

Management of surgical injuries is not likely to be altered by the substitution of MRI for CT but superior detection of non surgical lesions with MRI affects the medical management and predict the degree of neurological recovery.

2.3.4. Cerebral Angiography

Need for cerebral angiography for head injury has dramatically declined with the development of CT, CT Angiography and MR Angiography.

However Angiography has a role in managing and demonstration of following vascular injuries;

- Pseudo aneurysms
- Dissection
- Neuro interventional procedures for uncontrollable haemorrhages

2.3.5 Other imaging modalities

Following imaging modalities which deal with function of the brain has a very limited role in acute head trauma. These include

- SPECT
- PET (Positron Emission Tomography)
- Xenon enhanced CT

2.3.6 Trans cranial Doppler (TCD)

Transcranial Doppler offers a non invasive method of assessing cerebral blood flow regarding velocity and resistance of the major vessels of the circle of Willis.

2.4 Clinical Manifestation of Head Trauma

Variant: Skull fractures

| Radiological Procedure | Recommendation | Rating | Comment |
|------------------------------|-------------------|--------|---------|
| X-Ray Skull | most appropriate | X | |
| CT with Contrast | least appropriate | Z | |
| CT without Contrast | Most appropriate | X | |
| Sonography Trans cranial | Not indicated | Z | |
| Contrast Studies Angiography | Not indicated | Z | |
| MRI | Least appropriate | Z | |
| Radionuclide scanning | Not indicated | | |
| Interventional & Angiography | Not indicated | | |

Variant: Intra cranial haemorrhages

| Radiological Procedure | Recommendation | Rating | Comment |
|------------------------------|-------------------|--------|---------|
| X-Ray Skull | least appropriate | Z | |
| CT with Contrast | least appropriate | Z | |
| CT without Contrast | Most appropriate | X | |
| Sonography Trans cranial | Not indicated | Z | |
| Contrast Studies Angiography | Complimentary | | |
| MRI | Least appropriate | Z | |
| Radionuclide scanning | Not indicated | | |
| Interventional & Angiography | complimentary | | |

Variant: Intra cranial vascular injuries

| Radiological Procedure | Recommendation | Rating | Comment |
|-------------------------------|-----------------------|---------------|----------------|
| X-Ray Skull | Not indicated | Z | |
| CT Angiography | most appropriate | X | |
| CT without Contrast | Appropriate | Y | |
| Sonography Trans cranial | Most appropriate | X | |
| Contrast Studies Angiography | Most appropriate | X | |
| MRI Angiography | Most appropriate | X | |
| Radionuclide scanning | Complimentary | | |
| Interventional & Angiography | Not indicated | | |

Reference

- **NHS Radiology Guideline 2001**
- **National Guideline Clearing House - www.gudeline.com**
- **Imaging Department Protocols – University Hospital Birmingham**
- **[http : // www.emedicine. Com/ radio/ topic 397.htm](http://www.emedicine.com/radio/topic397.htm)**