CT Head in ED

A point of care guide to interpreting CTBs and rationalising their use in ED

Dr Kirsty Short, ECI Advanced Trainee
ECI recommended neuroanatomy website

ECI recommended reading
Links on the ECI Radiology Clinical Tools Homepage

*Reading a Head CT: What Every Emergency Physician Needs to Know*
Dr Andrew Perron (Emergency Physician, Maine USA)
Presented at the ACEP Scientific Assembly, Oct 2011

*How to read a head CT factsheet* from the Auckland Improving ED Care website
http://improvingedcare.org/?s=head+CT
Non contrast CT Brain

• Imaging modality of choice in investigating head injury

• Strong predictors of abnormal CT imaging in head injury:
  – Seizure
  – Focal neurology
  – Sign’s of base of skull fracture
  – Anticoagulants/bleeding diathesis
Clinical Decision Rules in Head Injury

• Help guide CT imaging particularly in *minor head injuries*

• Designed with the intention to allow more selective ordering of CTs, limiting cost and radiation

• Not a substitute for clinical judgement
Who should we scan?

- **CANADIAN CT HEAD RULES (CCHR)**

Panel 1: Canadian CT Head Rule

CT Head Rule is only required for patients with minor head injuries with any one of the following:

High risk (for neurological intervention)
- GCS score <15 at 2 h after injury
- Suspected open or depressed skull fracture
- Any sign of basal skull fracture (haemotympanum, ‘raccoon’ eyes, cerebrospinal fluid otorrhoea/rhinorrhaea, Battle’s sign)
- Vomiting $\geq$ two episodes
- Age $\geq$ 65 years

Medium risk (for brain injury on CT)
- Amnesia before impact $>30$ min
- Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height $>3$ feet or five stairs)

Minor head injury is defined as witnessed loss of consciousness, definite amnesia, or witnessed disorientation in a patients with a GCS score of 13–15.
• **NEW ORLEANS CRITERIA (NOC)**

CT required if GCS 15 and 1 of the following:
- Headache
- Vomiting
- >60yo
- Drug and alcohol intoxication
- Persistent anterograde amnesia
- Visible trauma from above the clavicles
- Seizure

• CCHR and NOC found to be 100% sensitive for injuries requiring neuroSx intervention, CCHR more specific (JAMA, 2005)
• **NEXUS II** – development included paediatric pts

CT recommended if **BEAN BASH**

- **B**ehaviour abnormal
- **E**mesis intractable
- **A**ge >65yo
- **N**eurological deficit
- **B**leeding disorder
- **A**ltered mental state
- **S**kull #
- **H**aematoma scalp

• 98.3% sensitive for clinically significant head inj
ACEM Guideline: Blunt Trauma
ACEM Guideline:
When to image without a trauma history
CTB Interpretation

Symmetry, symmetry, symmetry and comparison with old CTs

Axial, coronal and sagittal views
CT Basics

• Radiation considerations
• Orientation
• Views
• Windows
• Hounsfield Units
ED Checklist: Neurosurgical Emergencies

1) Is there midline shift?
2) Do the two sides of the brain look symmetrical?
3) Can you see the:
   • ‘Smile’ – Quadrigeminal cistern?
   • ‘Pentagon’ – Suprasellar cistern (MCA)?
   • Pre-pontine cistern (basilar artery)?
4) Is the 4th ventricle midline and symmetrical?
5) Is there ventricular enlargement?
5) Is there effacement of the surface sulci?
CTB: Common CT Pathologies
Haemorrhage

• Non-traumatic (aneurysm, hypertension, AVMs)
• Traumatic
• Intra or extra axial
  – Acute – hyperdense
  – Subacute – isodense (cf brain)
  – Chronic – hypodense (CSF)
• Mass effect
• Secondary hydrocephalus
EXTRADURAL

LOCATION:
- Between skull and dura

INVOLVED VESSEL:
- Temporoparietal
  - Middle meningeal artery
- Frontal
  - Anterior ethmoid artery
- Occipital
  - Transverse/sigmoid sinus
- Vertex
  - Superior sagittal sinus

CLINICALLY:
- Lucid interval followed by unconsciousness

CT APPEARANCE:
- Biconvex lens
SUBDURAL

LOCATION:
➢ Between dura and arachnoid

INVOLVED VESSEL:
➢ Bridging veins

CLINICALLY:
➢ Gradually increasing headache and confusion

CT APPEARANCE:
➢ Crescent-shaped
**SUBARACHNOID**

**LOCATION:**
- Subarachnoid space

**PATHOLOGY:**
- Berry aneurysm rupture
- Trauma
- Rupture of AVM
- Haemorrhagic diathesis

**CT APPEARANCE:**
- Blood in Sylvian fissure and cisterns
- Seen as linear densities
- CTA required
INTRA-PARENCYMAL
Stroke

• **Goals of CT in the acute setting are:**
  – Exclude intracranial haemorrhage, which would preclude thrombolysis
  – Look for any "early" features of infarction
  – Exclude other intracranial pathologies that may mimic a stroke (eg. tumour)
• **Immediate**
  – Hyperdense MCA Sign (or basilar sign)

• **Early (1-3 hours) (hyperacute phase)**
  – Signs depend on the site of occlusion and the presence of collateral flow. Early features include:
    • Loss of grey-white matter differentiation
    • Hypoattenuation of basal ganglia - visible in 75% of patients at 3 hours 6
    • Cortical hypodensity with associated parenchymal swelling and gyral effacement → vulnerable insular ribbon
• **First week**
  – More marked hypo-attenuation, swelling and mass effect

• **Second to third week**
  – Swelling starts to subside and small amounts of cortical petechial haemorrhages results in elevation of the attenuation of the cortex. This is known as the CT fogging phenomenon → cortex can appear near normal on CT

• **Months**
  – Gliosis sets in eventually appearing as a region of low density with negative mass effect
Dense MCA sign on left
Insular Ribbon Sign on Left

- Loss of the normal insular cortex grey-white differentiation

<4 hours | >4 hours
Hypoattenuation
R MCA infarct (established)
Infection

• Meningitis/encephalitis = largely a clinical Dx

• CT can assist diagnosis of complications of infection:
  – Raised ICP
  – Hydrocephalus
  – Abscess/subdural empyema
  – Infarction
• Abscesses can look like SOL or infarctions initially

• Typical ‘Ring enhancing lesion’ seen at 4-5 days (contrast CT)
DDx: Ring Enhancing Lesions

**MAGIC DR L**

- **M**etastases
- **A**bscesses
- **G**lioblastoma Multiforme
- **I**nfarct (subacute phase)
- **C**ontusion
- **D**emyelination
- **R**adiation necrosis
- **L**ymphoma
Radiological signs suggestive of raised ICP

- Surface sulcal effacement
- Empty sella sign (pituitary fossa filled with CSF)
- Poor grey-white matter distinction (oedema)
- Cistern effacement/asymmetry
- Hydrocephalus OR ventricular compression
- Midline shift
- Herniation (very late sign)
  - Subfalcine, transtentorial, tonsillar, uncal
Tumours

• Variety of appearances possible
  – Mass lesion
  – Oedema
  – Haemorrhage into mass
  – Ring-enhancing lesion
  – Associated hydrocephalus

• Consult radiology and neurosurgery – contrast CT or MRI will be required
Hydrocephalus

- Ventricular dilatation
- Acute/chronic
- Communicating/non-communicating
- Search for underlying cause
Internet Images


Additional References

Reading a Head CT: What Every Emergency Physician Needs to Know
Dr Andrew Perron (Emergency Physician, Maine USA)
Presented at the ACEP Scientific Assembly, Oct 2011

ACEM Diagnostic Imaging Guideline, Dec 2013
Available from:

