Brain Imaging

Common CT attenuation values

Structure	Attenuation value in HU
Air	From -500 To -1000 HU
Fat	From -10 To - 200 HU
Water	From 0 To 15 HU
Brain tissue	From 30 To 40 HU
Recent hematoma	From 60 To 90 HU
Calcifications	More than 100 HU
Bone	From 200 HU and above
Brain edema and infarction	around 20 HU
Normal liver parenchyma	around 60 HU

Common MR signal behaviors

■ Low signal in T1 and low signal in T2
- Cortical bone
- Calcifications
- Mature fibrous tissue
- Flowing blood
- Air (minimal hydrogen)

■ High signal in T1 and high signal in T2
- Subacute blood (extracellular met Hb)

■ High signal in T1and low signal in T2
- Fat and fat like structures (lipoma, dermoid cyst, ..)

■ Low signal in T1 & high signal in T2 [fluid signal]
- Any normal structure or lesion not included in the previous lists

Examples: CSF, brain edema, most of brain tumours,...

CT Brain

Indications:

Congenital anomalies	:	Hydrocephalus
Traumatic insults	:	Fractures & suspected intracranial hage
Inflammatory lesions	:	Brain abscess, TB, viral encephalitis,..
Neoplastic lesions	:	Benign & malignant intracranial neoplasms
Vascular lesions	:	Aneurysm, AVM,...
Miscellaneous	:	Cerebro vascular stroke, epilepsy,...

Technique of examination:

- Patient's preparation: no prepration is needed unless for patients who need contrast injection or anasethesia (children, uncooperative patients) : In such cases fasting 6 hours before examination is necessary
- Patient's position: Supine for axial sections, prone for coronal sections
- Scanogram: Lateral
- Contrast medium (whenever indicated): 60 - 80 ml of 60% iodinated contrast agent (urographin, telebrix, urovison, ...) injected intravenously just before the start of examination
- Start line paralled to the orbito metal line
- Section thickness 10mm [7mm for children]
- Average number of sections 12- 14
- Bone window for basal sections (1-4) and soft tissue window for all sections

■ Indications for contrast injection:

Contrast injection is usually judged by the radiologist in charge of the CT unit, generally we do not inject contrast material in these conditions:

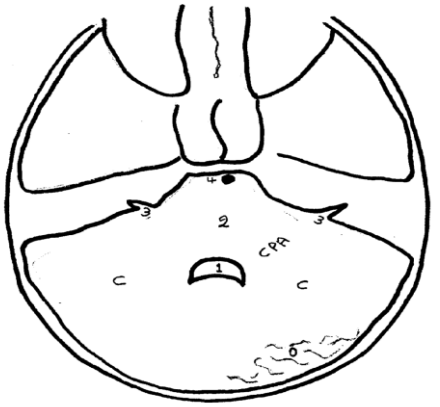
- Patients presenting with head trauma or cerebrovascutar strokes
- Patients with history of severe allergy to contrast media
- Patients with poor renal function. [creatinine above 3 mg]

Brain anatomy:

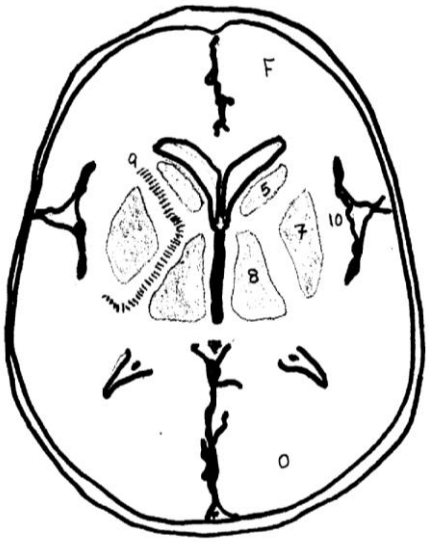
- Infraventricular level (posterior fossa cuts)
- Ventricular level (level of the lateral ventricles)
- Supraventricular level (cuts above the ventricles)

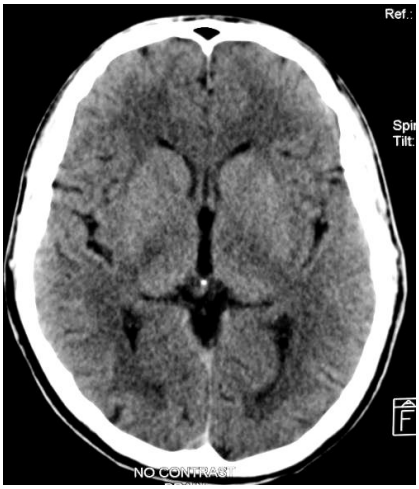
Infraventricular level:

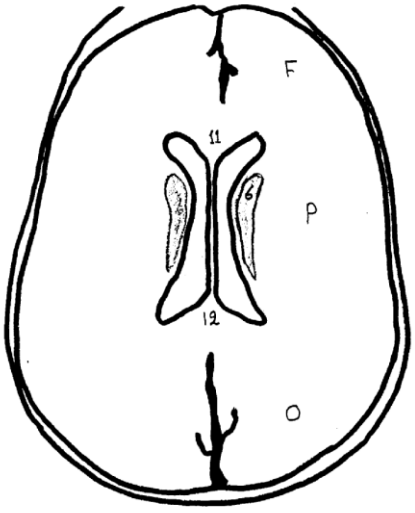
- 4th ventricle is the most important anatomical landmark
- Brain stem (anterior to the 4th ventricle) (medulla, pons,midbrain)
- Cerebellum (postro- lateral to the 4th ventricle)
- Cerebellar vermis (posterior to the 4th ventricle in the midline)



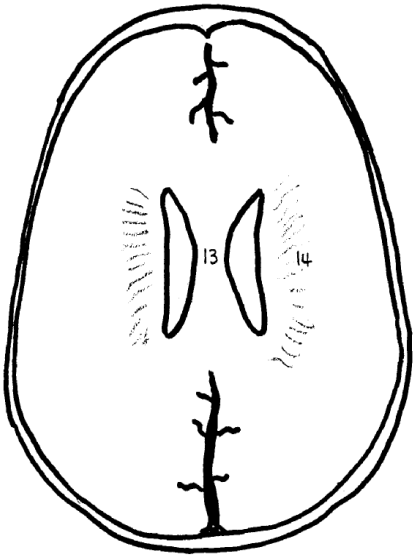
1 Fourth ventricle
2 Brain stem
3 Cerebello pontine angle
4 Basilar artery
5 Caudate nuclear (head)
6 Caudate nuclear (body)
7 Lantiform nuclear
8 Thalamus
9 Internal capsule
10 Insula
11 Genu of corpus callosum
12 Splenium of corpus callosum
13 Body of corpus callosum
14 Corona radiate
15 White matter
16 Gray matter







CPA = Cerebello pontine angle
F = Frontal lobe
P = Parietal lobe
O = Occipital lobe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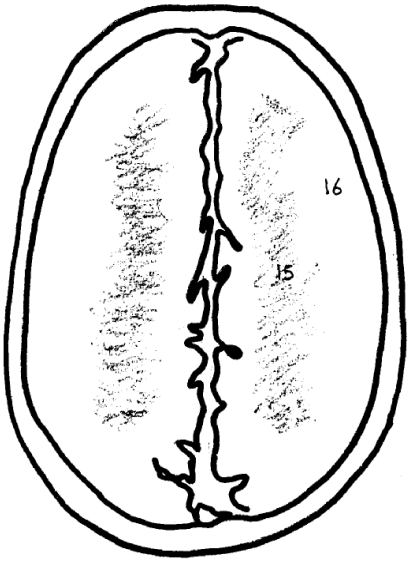
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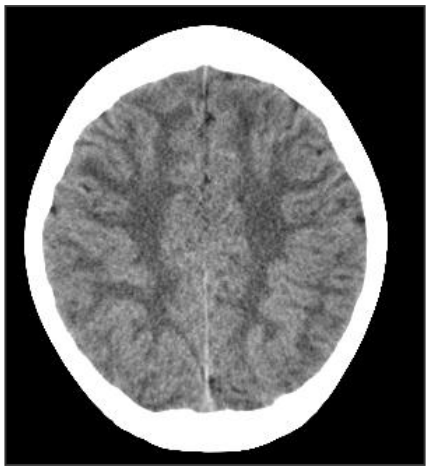
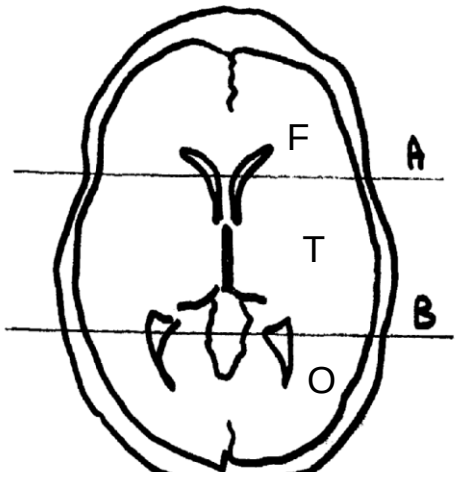
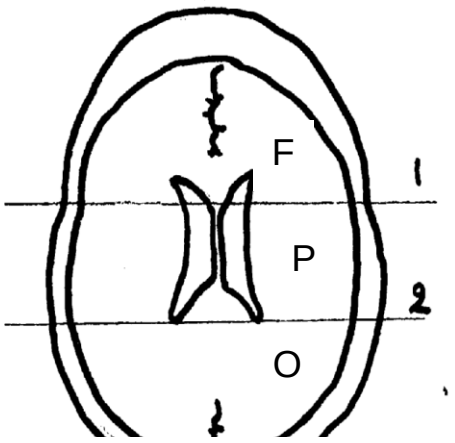


- Ventricular level
  - Lower section (Basal ganglia cuts)will show the caudate nucleus, lentiform nucleus, thalamus, internal capsule as well as quadrigeminal cistern like a cup with the midbrain lying in its concavity
  - Upper section (level of the ventricular body) The body and tail of the candate nucleus are seen adjacent to the ventricular wall.
  - The ventricles are separated by the septum pellucidum. The grey white matter interface is evident.

- Supra ventricular level
  Cerebral hemisphres, grey white matter interface and midline plane
- Lobar anatomy



Lower section



Upper section

P = Patient lobe
O = Occipital lobe

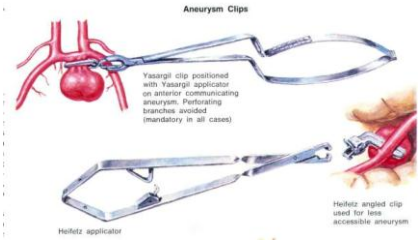
Brain MRI

General advantages of MRI

- Multiplanar imaging (axial , sagittal, coronal,oblique,...)
- No ionizing radiation
- Tissue characterization
- Visualization of vascular structures without the need for contrast injection (signal void phenomena)
- Allow some investigations to be done without contrast injection (MR angiography,MR myelography, MR cholangiography, ...)

Limitations to MRI

- Absolute contraindications to MR examination
  - Cardiac pace maker
  - Clipping of an intracranial aneurysm
  - Intraocular metalic FB
- Relative contraindication:
  - Marked obesity → open magnet
  - Colostrophobia → anaesthesia, or open magnet
  - Metalic implants degrading the scan quality
  - Relative high cost + relative limited availability ?!



Indications of Brain MRI

Similar to indications of CT brain scan + other indications where MRI is superior to CT such as:

- Diagnosis of certain diseases like white matter lesions, temporal lobe epilepsy and craniocervical junction pathology
- Diagnosis of vascular lesions without the need for contrast injection (signal void phenomena, MR angiography,...)
- Better assessment of certain anatomic regions such as the posterior fossa , temporal lobes,pituitary and suprasellar areas,...
- Confirmation of the CT diagnosis of certain lesions by:
  - Better orientation due to multiplanar imaging
  - Tissue characterization (MR can differentiate fluid, fat, blood,...)
  - Absence of bone artifacts
  - Adequate delineation of blood vessels

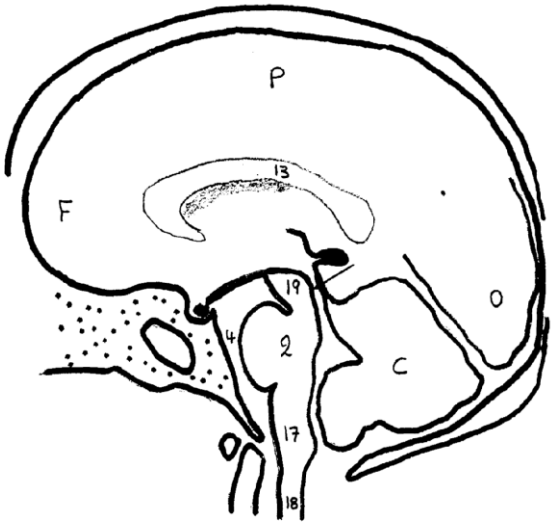
Contrast media:
Contrast medium for MRI is Gadolinium- DTPA injected intravenously in a dose of 0.1- o.2 ml/kgm body weight

MR technique:
The MR protocol for brain imaging should include:
- Sagittal T1 WIs
- Axial T1and FLIR weighted images

NB: Proton density was an old sequence, now replaced by the FLAIR sequence where CSF is black like T1 images and most of the pathologic conditions show high signal like T2 WIs. Lesion that are similar to CSF (arachnoid cyst, late encephalomalacia,..) will appear black on FLAIR sequence.

- If contrast material is injected we add axial, sagittal and/or coronal TI WIs after contrast injection. Gadolinium only affects the T1 WIs

NB The usual section thickness is 5mm with interslice gap of 2mm unless indicated otherwise.



1 Fourth ventricle
2 Pons
3 Cerebello pontine angle cistern
4 Pre pontine cistern & basilar artery
5 Head of caudate nucleus
6 Body of caudate nucleus
7 Lentiform nucleus
8 Thalamus
9 Internal capsule
10 Insula
11 Genu of corpus callosum
12 Splenum of corpus callosum
1 3 Body of corpus callosum
14 Corona radiata
15 White matter
16 Gray matter
17 Medulla oblogata
18 Upper cervical cord
1 9 Mid brain

C= Cerebellum**, CPA=** Cerebello pontine angle, **F=** frontal lobe, **O=** occipital lobe, **P=** parietal lobe, **arrow=** aquiduct of sylvius