NEURORADIOLOGY
DIL part 1
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GOALS

• Upon completion of these modules, you will have reviewed some basic neuroanatomy, learned a standard approach to CT head interpretation, and reviewed some common intracranial pathologies including bleeds, strokes and tumors.

• I suggest getting through modules 1 and 2 during this 1 hour time allotment. Modules 3-5 can be used as references as the pathologies are discussed during this neuro session.
Overview

• Introduction to Neuroimaging - DIL part 1
• Basic Brain Anatomy - DIL part 1
• Standardized Approach to Image Interpretation - DIL part 2
• Common Pathology
  • Bleeds (Hemorrhages) - DIL part 3
  • Strokes (Infarcts) DIL part 4
  • Masses (Tumors) part 5
INTRODUCTION

- The primary imaging modalities for neuroradiology include computed tomography (CT) and magnetic resonance imaging (MRI).
INTRODUCTION

- CT (computed tomography)
  - Initial screening study for neurological pathology.
  - Can be performed without or with intravenous contrast.
  - Pros: easily accessible, relatively inexpensive, fast (great for emergency cases).
  - Cons: not very sensitive or specific for certain pathologies, radiation to patient.
INTRODUCTION

• MRI

  • Often used to further evaluate findings made by CT.
  
  • Can also be performed without or with contrast.

  • Pros: More sensitive and more specific than CT for many pathologies, useful problem-solving tool, no radiation.

  • Cons: Certain metal implants are contraindications, claustrophobia, expensive, less available, time consuming, and also not sensitive or specific for certain pathologies.
INTRODUCTION

• The following two slides will show you examples of a CT and an MRI, so you can start to recognize the type of study being performed. We have to start somewhere!
Features of a CT:
- Bones are white
- Grey matter is lighter than white matter
- CSF is black
• When you add IV contrast, notice a few things happen:
  • Choroid plexus enhances
  • The vessels are now bright
MRI

- Features of a T1 MRI:
  - Bones are black
  - Grey matter is darker than white matter
  - Grey-white differentiation is more distinct than on CT
  - CSF is black
MRI

- Features of a T2 MRI
  - Bones are black
  - Grey matter is brighter than white matter
  - CSF is white
  - Maybe you can remember that water is white for T2's. Water white. WW. 2W's. T2.
In addition to T1 and T2, there are many other MRI sequences that are beyond the scope of this session.
CROSS SECTIONAL CONVENTIONS

- All CT's and MRI's are displayed in the same manner when you view them on a screen.

- The following slide will describe the standard convention.
CROSS SECTIONAL CONVENTIONS

- When you are looking at a transverse axial image, you should be familiar with the conventional orientation.
  - Image right = patient's left
  - Image left = patient's right
  - Image top = patient's anterior
  - Image bottom = patient's posterior

Axial
MULTIPLE PLANES

• Cross-sectional imaging is great because we can display it in different planes. This can be very helpful to localize a finding to a precise anatomic location.

• The common planes are TRANSVERSE AXIAL, CORONAL, and SAGITTAL.

• The next slide shows examples.
MULTIPLE PLANES

- The green slice cuts through the patient like a loaf of bread.
- This results in the transverse axial plane you're used to seeing.

[Image: commons.wikimedia.org/wiki/File:Human_anatomy_planes.jpg]
MULTIPLE PLANES

- The blue slice produces the coronal plane.

MULTIPLE PLANES

- The red slice cuts the patient down the midline and produces the sagittal plane.

MULTIPLE PLANES

Transverse Axial  Coronal  Sagittal
MULTIPLE PLANES

• You've likely noticed that throughout this module, whenever there is a CT or MRI displayed, the plane of imaging will be written in the bottom right corner.

• This will help to orient you as you go through the cases.

• For example, this one is labelled "axial."
MULTIPLE WINDOWS

- Images can be acquired in a certain manner to better display certain structures. Once an image has been obtained, the radiologist can further modify these settings. Part of what is being altered is the "window."

- Look at this example of a CT with brain windows compared to the one beside it with bone windows.

- Notice how much better you can assess the brain on the left. Imagine trying to assess the brain on the right!
MULTIPLE WINDOWS

Brain Windows

Bone Windows

Axial
OVERVIEW

• Introduction to Neuroimaging

• Basic Brain Anatomy

• Standardized Approach to Image Interpretation

• Common Pathology
  • Bleeds (Hemorrhages)
  • Strokes (Infarcts)
  • Masses (Tumors)
ANATOMY

1. Lobar Anatomy
2. Major Fissures
3. Ventricular System
4. Basal Ganglia
5. White Matter Tracts (Corpus Callosum and Internal Capsule)
6. Brainstem
7. Cerebellum
8. Dural Folds (Falx and Tentorium)
9. Major Vessels (Circle of Willis)
FRONTAL LOBE
FRONTAL LOBE
FRONTAL LOBE

Axial
FRONTAL LOBE
FRONTAL Lobe
FRONTAL LOBE
FRONTAL Lobe
FRONTAL LOBE
FRONTAL LOBE
FRONTAL LOBE
FRONTAL LOBE
TEMPORAL LOBE
TEMPORAL LOBE

Axial
TEMPORAL LOBE
TEMPORAL LOBE
TEMPORAL LOBE
TEMPORAL LOBE
PARIETAL LOBE
PARIETAL LOBE
PARIETAL LOBE
PARIETAL LOBE
PARIETAL LOBE
PARIELTAL Lobe
PARIETAL LOBE
PARIETAL LOBE
OCCIPITAL LOBE
OCCIPITAL LOBE
OCCIPITAL LOBE
OCCIPITAL LOBE
OCCIPITAL LOBE
OCCIPITAL LOBE
MAJOR FISSURES

- Central Sulcus - separates frontal and parietal lobe.
- Parieto-occipital sulcus - separates parietal and occipital lobes.
- Lateral Sulcus (Sylvian fissure) - separates the frontal and parietal lobes from the temporal lobe.
CENTRAL SULCUS
CENTRAL SULCUS

Separates the frontal and parietal lobes.
PRECENTRAL GYRUS
The part of the posterior frontal lobe that lies immediately anterior to the central sulcus.

This is the where the primary motor cortex resides.
POSTCENTRAL GYRUS
POSTCENTRAL GYRUS

The part of the anterior parietal lobe, immediately posterior to the central sulcus.

This is where the primary somatosensory cortex resides.
CENTRAL SULCUS
CENTRAL SULCUS
PRECENTRAL GYRUS
POSTCENTRAL GYRUS
POSTCENTRAL GYRUS
PARIETO-OCCIPITAL SULCUS
PARIETO-OCCIPITAL SULCUS

Separates the parietal and occipital lobes
SYLVIAN FISSURE

Separates the frontal and parietal lobes from the temporal lobe
SYLVIAN FISSURE
SYLVIAN FISSURE
SYLVIAN FISSURE
SYLVIAN FISSURE
VENTRICULAR SYSTEM

- Ventricular System
  - Right and left lateral ventricles
  - Paired interventricular foramen
  - Third ventricle
  - Cerebral aqueduct
  - Fourth ventricle
  - Central canal

http://commons.wikimedia.org/wiki/File:Blausen_0896_Ventrices_Brain.png
VENTRICULAR SYSTEM
VENTRICULAR SYSTEM

• Lateral ventricle
• Third ventricle
• Fourth Ventricle

Sagittal
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES

Coronal
LATERAL VENTRICLES

Coronal
LATERAL VENTRICLES
LATERAL VENTRICLES
LATERAL VENTRICLES
THIRD VENTRICLE
THIRD VENTRICLE

Also note the lateral ventricles draining via the bilateral interventricular foramen into the third ventricle.
THIRD VENTRICLE
THIRD VENTRICLE
CEREBRAL AQUEDUCT

Axial
CEREBRAL AQUEDUCT
CEREBRAL AQUEDUCT
Recall that the third ventricle drains via the cerebral aqueduct into the fourth ventricle.
FOURTH VENTRICLE
FOURTH VENTRICLE
FOURTH VENTRICLE
FOURTH VENTRICLE
BASAL GANGLIA

- Caudate Nucleus
- Lentiform nucleus = globus pallidus + putamen
- Thalamus
- There are other parts of the basal ganglia not covered, including: Substantia Nigra, Subthalamic Nucleus, Red Nucleus.
CAUDATE
CAUDATE
CAUDATE
Specifically, this is the part of the caudate nucleus called the "head."
CAUDATE
CAUDATE
CAUDATE

Coronal
CAUDATE
LENTIFORM NUCLEUS

Axial
Recall that the lentiform nucleus is comprised of the putamen and the globus pallidus.
THALAMUS
INTERNAL CAPSULE
INTERNAL CAPSULE
The internal capsule is a white matter tract that separates the lentiform nucleus from the caudate nucleus and thalamus.
CORPUS CALLOSUM

Axial
CORPUS CALLOSUM

White matter tract that connects the two cerebral hemispheres.
CORPUS CALLOSUM

Axial
CORPUS CALLOSUM

Axial
CORPUS CALLOSUM
CORPUS CALLOSUM
CORPUS CALLOSUM
CORPUS CALLOSUM
CORPUS CALLOSUM
MIDBRAIN

Axial
MIDBRAIN
MIDBRAIN
MIDBRAIN

Coronal
MIDBRAIN

Sagittal
Do you remember the name of the CSF tract that passes through the midbrain?
Do you remember the name of the CSF tract that passes through the midbrain?

It's the cerebral aqueduct!
PONS
PONS

Coronal
PONS

Coronal
PONS
MEDULLA
MEDULLA
MEDULLA

Coronal
MEDULLA
MEDULLA
CEREBELLUM
CEREBELLUM
CEREBELLUM
CEREBELLUM
CEREBELLUM

Axial
CEREBELLMUM
CEREBELLUM

Coronal
CEREBELLUM
CEREBELLUM
FALX CEREBRI
FALX CEREBRI

Axial
FALX CEREBRI

Coronal
TENTORIUM CEREBELLI
MAJOR VESSELS

MAJOR VESSELS

The vessels we will review on imaging are the ones highlighted.

CIRCLE OF WILLIS - ICA

ICA = Internal Carotid Artery

Axial
CIRCLE OF WILLIS - ICA

ICA = Internal Carotid Artery
CIRCLE OF WILLIS - MCA

MCA = Middle Cerebral Artery
CIRCLE OF WILLIS - MCA

MCA = Middle Cerebral Artery
CIRCLE OF WILLIS - ACA

ACA = Anterior Cerebral Artery
CIRCLE OF WILLIS - ACOM

ACOM = Anterior Communicating Artery
The ACOM connects the left and right ACAs.
CIRCLE OF WILLIS - PCOM

PCOM = Posterior Communicating Artery
PCOM = Posterior Communicating Artery

PCOM connects the anterior and posterior circulation.
BASILAR ARTERY
The basilar artery is the distal continuation of the vertebral arteries, supplying the posterior circulation.
CIRCLE OF WILLIS - PCA

Axial
CIRCLE OF WILLIS - PCA

PCA = Posterior Cerebral Artery

The PCAs loop backwards around the midbrain.
CIRCLE OF WILLIS - PCA

PCA = Posterior Cerebral Artery
CIRCLE OF WILLIS - PCA

PCA = Posterior Cerebral Artery
End of module 1

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