HEAD AND NECK IMAGING

James Chen (MS IV)
Anatomy Course
Johns Hopkins School of Medicine

Sept. 27, 2011
OBJECTIVES

- Introduce cross sectional imaging of head and neck
  - Computed tomography (CT)

- Review head and neck anatomy
  - Major anatomical landmarks on imaging
    - Bone
    - Ventricles
    - Brain
    - Vessels
CROSS SECTIONAL VIEWS

- **Sagittal**
  - Superior
  - Inferior

- **Coronal**
  - Superior
  - Inferior

- **Axial**
  - Anterior
  - Posterior
INTRODUCTION TO CT: RULES OF LIGHT AND DARK

- Bright = high density
  - Bone
INTRODUCTION TO CT:
RULES OF LIGHT AND DARK

- Bright = high density
  - Bone

Calvarium appears bright (Bone)
INTRODUCTION TO CT:
RULES OF LIGHT AND DARK

- **Bright** = high density
  - Bone
  - Blood
INTRODUCTION TO CT: RULES OF LIGHT AND DARK

- **Bright** = high density
  - Bone
  - Blood

Parenchymal Hemorrhage (Blood)
INTRODUCTION TO CT: RULES OF LIGHT AND DARK

- **Bright** = high density
  - Bone
  - Blood
  - Bullets (hardware)
INTRODUCTION TO CT: RULES OF LIGHT AND DARK

- **Bright** = high density
  - Bone
  - Blood
  - Bullets (hardware)

- **Dark** = low density
  - Air
  - Water (fluids)

- **Gray** = in between
  - Soft tissue

Bullet – note artifact from metal
INTRODUCTION TO CT: WINDOWING

- Image brightness/contrast adjusted to accentuate particular structures
INTRODUCTION TO CT: 
CONTRAST

- Intravenous contrast makes vessels bright
NECK IMAGING

- Cervical vertebrae
  - Cross sectional anatomy

- Vasculature
  - Carotid arteries
  - Vertebral arteries
CERVICAL VERTEBRAE

Sagittal (bone window)
Cervical Vertebrae

- Articulation allows head movement
  - C1 - atlas
  - C2 – axis

- Protects vital neural and vascular structures
  - Cervical spinal cord
  - Vertebral arteries

- Damage can result in significant morbidity

Sagittal (bone window)
Which cervical vertebral level is this axial section?
Axial

Level of Atlas
NECK IMAGING

- Cervical vertebrae
  - Cross sectional anatomy

- Vasculature
  - Carotid arteries
  - Vertebral arteries
Cervical Vessels

- Large vessels of the neck deliver blood supply to the brain

- Anterior and posterior circulations
  - **Anterior**: Carotid arteries
  - **Posterior**: Vertebral arteries

- Disrupted flow can result in significant morbidity
VASCULATURE:
CAROTID ARTERIES

Sagittal

Coronal
VASCULATURE:
COMMON CAROTIDarteries
VASCULATURE:
INTERNAL CAROTID ARTERIES

Sagittal

Coronal
VASCULATURE: EXTERNAL CAROTID ARTERIES

Sagittal

Coronal
Vasculature:
Vertebral Arteries

Vertebral Arteries (coronal)

Vertebrobasilar arteries (coronal)
Vasculature:
Vertebral Arteries

Vertebral Arteries (coronal)
Vertebrobasilar arteries (coronal)
VASCULATURE:
AXIAL IMAGES

Axial

Coronal
Vasculature: Axial Images

Common Carotid Arteries

Below carotid bifurcation
VASCULATURE:
AXIAL IMAGES

Vertebral Arteries
VASCULATURE:
AXIAL IMAGES
VASCULATURE:
AXIAL IMAGES

External carotid arteries

Above carotid bifurcation
VASCULATURE: AXIAL IMAGES

Internal carotid arteries

Above carotid bifurcation
VASCULATURE:
AXIAL IMAGES

Vertebral arteries

Above carotid bifurcation
CASE: ARTERIAL ABNORMALITY

Axial

Which vessels are these?

Abnormal

Normal
CASE:
CAROTID ARTERIES

Axial

Calcifications in atherosclerotic plaques
CASE:
CAROTID ARTERIES

Which vessels are affected by atherosclerosis
- A. Vertebral arteries
- B. Common carotid arteries
- C. External carotid arteries
- D. Internal carotid arteries

Internal POSTERIOR to external carotid artery above bifurcation
HEAD IMAGING

- Paranasal Sinuses
  - Bony walls and contents

- Ventricles
  - Normal vs. Enlarged

- Parenchyma
  - Basic anatomy and midline shift

- Vasculature
  - Hemorrhage types
Paranasal Sinuses

- Paired air-filled spaces around nasal cavity
  - Frontal, ethmoid, sphenoid, maxillary

- “Normal” varies
  - Development occurs prenatally and after birth
  - Shape and size of sinuses can differ between people

- Things to look for:
  - Are the bony walls intact?
  - Is there anything in the sinus (air will appear black)?
SINUSES:

SPHENOID

Sagittal

Coronal
SINUSES:

Sphenoid
SINUSES:
SPHENOID

Sagittal  Coronal  Axial
SINUSES:
ETHMOID

Sagittal

Coronal
SINUSES:
ETHMOID

Sagittal  Coronal  Axial
Sinuses: Ethmoid

Sagittal

Coronal

Axial
Sinuses: Maxillary

Sagittal

Coronal
SINUSES:
MAXILLARY

Sagittal
Coronal
Axial
SINUSES:
MAXILLARY

Sagittal
Coronal
Axial
SINUSES:
FRONTAL

Sagittal
Axial
Sinuses:
Frontal

Sagittal
Axial
CASE: SINUS ABNORMALITY

Which sinuses do we see on this axial image?

- A. Frontal
- B. Ethmoid
- C. Maxillary
- D. Sphenoid
CASE:

**SINUS ABNORMALITY**

Left Maxillary Sinus

Right Maxillary Sinus (Normal)
Case: Facial Fracture

Fracture in anterior wall of left maxillary sinus

What is the likely cause of the abnormality?
- A. Neoplastic
- B. Trauma
- C. Infection
- D. Endocrine
HEAD IMAGING

- Paranasal Sinuses
  - Bony walls and contents

- Ventricles
  - Normal vs. Enlarged

- Parenchyma
  - Basic anatomy and midline shift

- Vasculature
  - Hemorrhage types
Cerebral Ventricles

- **Anatomy**
  - Lateral ventricles (paired)
  - Third ventricle
  - Fourth ventricle

- **Cerebrospinal fluid**
  - Produced in choroid plexus (lateral + third ventricles)

- **Approach on axial images**
  - Ventricles midline and symmetric?
  - Ventricles normal size?
  - Abnormal ventricle contents?
VENTRICLES SYMMETRIC?
**Ventricles Symmetric?**

Sagittal

Axial

Lateral ventricles symmetric
VENTRICLES IN MIDLINE?
VENTRICLES IN MIDLINE?

Choroid plexus (lateral ventricles) bright from calcium
VENTRICLES IN MIDLINE?

Ventricles equidistant from midline
NORMAL VENTRICULAR SIZE?

Axial

Normal

Axial

Enlarged (Hydrocephalus)
ABNORMAL VENTRICLE CONTENTS?

Normal CSF (dark)
BLOOD IN VENTRICLES

Intraventricular blood (bright)

Normal CSF (dark)

Intraventricular Catheter (helps reduce pressure by draining CSF)
HEAD IMAGING

- Paranasal Sinuses
  - Bony walls and contents

- Ventricles
  - Normal vs. Enlarged

- Parenchyma
  - Basic anatomy and midline shift

- Vasculature
  - Hemorrhage types
Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri
BRAIN PARENCHYMA

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri

Falx cerebri is dural fold separating left and right hemispheres.
BRAIN PARENCHYMA

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri
  - Cerebral cortex superior to brainstem and cerebellum
**Brain Parenchyma**

- **Basic anatomy**
  - Cerebral hemispheres divided by falx cerebri
  - Brainstem and cerebellum inferior to cerebral cortex

![Axial (Ax) view of Cerebrum (temporal lobes)](image1)

![Sagittal (Sag) view of Cerebrum](image2)
**Brain Parenchyma**

- **Basic anatomy**
  - Cerebral hemispheres divided by falx cerebri
  - Brainstem and cerebellum inferior to cerebral cortex
**Brain Parenchyma**

- **Basic anatomy**
  - Cerebral hemispheres divided by falx cerebri
  - Brainstem and cerebellum inferior to cerebral cortex
BRAIN PARENCHYMA

- Normal changes with age
  - Brain mass decreases
  - Surrounding CSF spaces appear larger (enlarged sulci, ventricles)
BRAIN PARENCHYMA

- Elements to consider on imaging:
  - Symmetry?
  - Falx cerebri in midline?
  - Abnormal mass (variable brightness) or edema (darker)?
  - Hemorrhage (bright)?
CASE:
BRAIN ABNORMALITY

Axial

Abnormal

Axial

Normal
CASE: BRAIN ABNORMALITY

What abnormalities are present?
- A. Compression of left lateral ventricle
- B. Intraventricular hemorrhage
- C. Midline shift
- D. A and C
What abnormalities are present?

- A. Compression of left lateral ventricle
- B. Intraventricular hemorrhage
- C. Midline shift
- D. A and C
CASE:
INTRACRANIAL ABNORMALITY

Axial

What is the cause of the mass effect?

- A. Trauma
- B. Hemorrhage
- C. Congenital
- D. Tumor
CASE:

INTRACRANIAL ABNORMALITY

What is the cause of the mass effect?
- A. Trauma
- B. Hemorrhage
- C. Congenital
- D. Tumor

Axial
Large mass in left frontal lobe
What is the cause of the mass effect?

- A. Trauma
- B. Hemorrhage
- C. Congenital
- D. Tumor

Significant edema related to mass
CASE: INTRACRANIAL ABNORMALITY

Axial

- What is the cause of the mass effect?
  - A. Trauma
  - B. Hemorrhage
  - C. Congenital
  - D. Tumor

Significant edema related to mass
**Head Imaging**

- **Paranasal Sinuses**
  - Bony walls and contents

- **Ventricles**
  - Size and symmetry

- **Parenchyma**
  - Basic anatomy and midline shift

- **Vasculature**
  - Hemorrhage
**INTRACRANIAL BLEEDING**

- Common use of **non-contrast** head CT
  - **NEW** blood appears **BRIGHT** (acute bleed)
  - **OLD** blood can be **DARK** (old bleed)

- Different locations

  - Epidural
  - Subdural
  - Subarachnoid
  - Parenchymal

Outside brain parenchyma
INTRACRANIAL BLEEDING

- Common use of **non-contrast** head CT
  - **NEW** blood appears **BRIGHT** (acute bleed)
  - **OLD** blood can be **DARK** (old bleed)

- Different locations
  - Epidural
  - Subdural
  - Subarachnoid
  - Parenchymal

**ARTERIAL hemorrhage**
**INTRACRANIAL BLEEDING**

- Common use of non-contrast head CT
  - NEW blood appears **BRIGHT** (acute bleed)
  - OLD blood can be **DARK** (old bleed)

- Different locations
  - Epidural
  - Subdural
  - Subarachnoid
  - Parenchymal

VENOUS hemorrhage
SUMMARY

- **Rules of CT**
  - High density = Bright (Bone, blood, bullets)
  - Low density = Dark (Air, CSF, edema)

- Normal anatomic landmarks on cross-sectional imaging
THANKS

- Questions?
  - James.chen@jhmi.edu

- Good luck on the rest of anatomy!