Educational Objectives

By the end of this lecture you should be able to:

- Explain patient preparation for cranial CT examinations
- Explain the CT protocol for:
  - Brain standard, Pituitary & sella turcica
  - Petrous temporal bone and inner ear
  - Orbits and facial bones
  - Paranasal sinuses
  - TMJ
- Identify the contrast volume and route of administration for each protocol
- Identify the standard windowing for each protocol
- Explain how to modify the technique according to patient condition
- Identify common pathologies on brain CT images
References

2. Protocols for Multislice Helical Computed Tomography, The fundamentals. by Peter Dawson

Websites

http://www.ctisus.org/
http://www.slaney.org/pct/

HEAD CT

PROTOCOLS

• BRAIN STANDARD
• PITUITARY & SELLA TURCICA
• PETROUS TEMPORAL BONE AND INNER EAR
• ORBITS
• FACIAL BONES
• PARANASAL SINUSES
• TMJ
Patient preparation for the Procedure

- explain the procedure to the patient.
- If the procedure involves the use of contrast dye, consent should be signed form the patient.
- Ask the patient if he has ever had a reaction to any contrast dye.
- Generally, there is no fasting requirement prior to a CT scan, unless a contrast dye is to be used.
- **IV contrast need fasting 4 hours before the examination.**

### HEAD CT

Positioning

The basic positioning of skull which used for skull radiography are used for all cranial CT. it is very important to ensure that there is no rotation or tilt of head in order to demonstrate any bilateral asymmetry due to pathologic processes.
**HEAD CT**

**Positioning**
- Patient Supine Head first
- Arms along the sides of the body
- Head immobilized in the head holder
- Support is placed under the head.

**Note:**
- *For coronal sections Patient position is prone*
- The specific positioning methods and routines for cranial CT vary, depending on radiologist preferences and departmental protocols.

**HEAD CT**

SCOUT: Lateral
LANDMARK: OML
GANTRY TILT: 0° to 10° from OM.
SLICE PLANE: Axial
BREATH HOLD: None
I.V. CONTRAST: As required (40-50ml)
START LOCATION: Foramen Magnum
END LOCATION: Vertex
SLICE THICKNESS:
- 5 mm (from skull base to tentorial rim)
- 10 mm (from tentorial rim to vertex)
**FILMING**
- Soft tissue (WW 140-1000 WL 30-100)
- Bone (WW 1500-3000 WL 200-400)

https://www.youtube.com/watch?v=Tx-0emi4m8s
BRAIN STANDARD

windowing

Soft-tissue

BRAIN STANDARD

Image Interpretation: What We Need to Know

Hypodense  Isodense  Hyperdense  Hypodense

CSF  brain  bone  air
**BRAIN STANDARD**

*Image Interpretation*

**What We Need to Know**

- Air is very black (less than -300 HU)
- Water/CSF is black (near 0 HU)
- Bone is very dense/white (500-3000 HU)
- Blood is white (40-90 HU)
- Brain is gray 35-50 HU

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**BRAIN STANDARD**

*Image Interpretation: What We Need to Know*

Normal calcifications??

And we are the choroid plexus

Hello! I am the pineal gland, always here!
Image Interpretation

What We Need to Know (On each slice look for)

- Symmetry of sulci and ventricles
- Grey-white differentiation

BRAIN STANDARD

Image Interpretation

Midline shift Evaluation
BRAIN STANDARD

Windowing

Soft-tissue

BRAIN STANDARD

Windowing

Bone window
BRAIN STANDARD

windowing: In Possibility of fractures

- Two films are printed:
  1) The 1st is soft tissue.
  2) The second is bone window.

Bone window showing depressed skull fracture

BRAIN STANDARD

Filming (Soft tissue)
**BRAIN STANDARD (Non contrast)**

**CT Density 68.6 HU**

**What is the Diagnosis?**

**Acute Intracerebral hematoma:**
- Acute hematoma is seen by non-contrast imaging as an area of high density with density numbers ranging from 40 to 90HU.

**Note:**
- Intracerebral hematoma is localized within the brain substance.

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**BRAIN STANDARD (Non contrast)**

**CT Density 72.9 HU**

**What is the Diagnosis?**

**Subdural hematoma:**
- Acute hematoma is seen by non-contrast imaging as an area of high density with density numbers ranging from 40 to 90HU.

**Note:**
- Subdural hematoma is located between the layers of dura and arachnoid mater, covering the cerebral hemispheres.
Subdural Hematoma:
- Recognized by CT as crescentic shaped increased density.
- Subdural hematoma can evolve over a period of time and thus classified as acute, sub acute and chronic hematoma.

Acute Subdural Hematoma:
Up to 7 day old High CT density (40-90HU)

Sub acute Subdural Hematoma
7 to 21 days old The CT density of acute blood gradually decreases and becomes isodense with adjacent brain, thus less readily visible and can be easily overlooked.

Chronic Subdural Hematoma:
Over 21 days ; Acute blood as it evolves, it undergoes liquefaction, and also mixes with cerebrospinal fluid from adjacent subarachnoid space, thus converting into a serosanguineous fluid. This fluid has low CT density reaching close or similar to cerebrospinal fluid.

Slow movement of subarachnoid fluid into the subdural hematoma can give rise to gradual expansion of subdural hematoma that can exert mass effect upon the adjacent brain with or without brain edema.
**BRAIN STANDARD (Non contrast)**

**What is the Diagnosis?**

**Subarachnoid Hemorrhage**

Is bleeding into the subarachnoid space surrounding the brain, the area between the arachnoid membrane and the pia mater.

Subarachnoid blood is recognized by visualizing the high-density of acute blood outlining the cerebral sulci and subarachnoid cisterns.

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**BRAIN STANDARD (Non contrast)**

**What is the Diagnosis?** Epidural Hemorrhage

buildup of blood occurring between the dura mater (the brain’s tough outer membrane) and the skull.
BRAIN STANDARD (Non contrast)

Normal CT Brain

Hydrocephalus

BRAIN- AXIAL

BRAIN STANDARD (Non contrast)

Brain Infarct

BRAIN- AXIAL
BRAIN STANDARD (with contrast)

BRAIN- AXIAL

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HEAD CT

PROTOCOLS

- BRAIN STANDARD
- PITUITARY & SELLA TURCICA
- PETROUS TEMPORAL BONE AND INNER EAR
- ORBITS
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- PARANASAL SINUSES
- TMJ

PITUITARY & SELLA TURCICA

SCOUT: Lateral
LANDMARK: OML
SLICE PLANE: Axial and Coronal
BREATH HOLD: None
I.V. CONTRAST: 50-80 ml
START LOCATION: 0.5 cm below hypophyseal region
END LOCATION: 0.5 cm above hypophyseal region
SLICE THICKNESS: 2-3 mm

FILMING
Soft tissue (WW140-300 WL 30-40)
Bone (WW 2000-3000 WL 200-400)
NOTES: Pre and post contrast cuts with the same plane and filming

https://www.youtube.com/watch?v=e-OwyZVMLSo
PITUITARY & SELLA TURCICA

Pituitary tumor

PITUITARY- CORONAL

HEAD CT

PROTOCOLS

› BRAIN STANDARD
› PITUITARY & SELLA TURCICA
› PETROUS TEMPORAL BONE AND INNER EAR
› ORBITS
› FACIAL BONES
› PARANASAL SINUSES
› TMJ
PETROUS TEMPORAL BONE AND INNER EAR

SCOUT: Lateral
LANDMARK: IOML
GANTRY TILT: IOML for axial & according to patient tilt for coronal.
SLICE PLANE: Axial and Coronal
BREATH HOLD: None
I.V. CONTRAST: None (Yes for tumors)
START LOCATION: F. Magnum
END LOCATION: Through petrous bone
SLICE THICKNESS: 1-2 mm, 1mm through Canal, 2 mm Petrous bone
FILMING: Soft tissue and Bone window
NOTES: High resolution CT is the recommended technique for demonstrating the air cells

INTERNAL AUDITORY CANAL

IAC- AXIAL
Mastoiditis
HEAD CT

PROTOCOLS

- BRAIN STANDARD
- PITUITARY & SELLA TURCICA
- PETROUS TEMPORAL BONE AND INNER EAR
- ORBITS
  - FACIAL BONES
  - PARANASAL SINUSES
  - TMJ

ORBITS

SCOUT: Lateral
LANDMARK: IOML
SLICE PLANE: Axial and Coronal
BREATH HOLD: None
I.V. CONTRAST: None for trauma case (Yes for tumors)

START LOCATION:
- Axial: Top of max. sinus
- Coronal: Sphenoid sinus

END LOCATION:
- Axial: Upper Orbital Rim
- Coronal: Anterior Globe

SLICE THICKNESS: 2-3 mm
FILMING: Soft tissue and Bone window
ORBITS

Coronal cut demonstrates a superior orbital fracture on the left orbit with fragments of bone extending toward the frontal lobe.

Coronal cut demonstrates an infra orbital fracture (Right side).

HEAD CT

PROTOCOLS

- BRAIN STANDARD
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- ORBITS
- FACIAL BONES
- PARANASAL SINUSES
- TMJ
**FACIAL BONES**

**SCOUT** : Lateral  
**LANDMARK** : IOML  
**SLICE PLANE** : Axial and Coronal  
**BREATH HOLD** : None  
**I.V. CONTRAST** : None (Yes for tumors)  
**START LOCATION** :  
Axial : Symphysis menti  
Coronal : E.A.M  
**END LOCATION** :  
Axial : Superior orbital margin  
Coronal : Anterior Globe  
**SLICE THICKNESS** : 2-3 mm  
**FILMING** : Soft tissue and Bone window
**FACIAL BONES**

Mandibular Fracture

MANDIBLE- AXIAL

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**HEAD CT**

**PROTOCOLS**

- BRAIN STANDARD
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  - PARANASAL SINUSES
  - TMJ
PARA NASAL SINUSES

SCOUT: Lateral
LANDMARK: OML
SLICE PLANE: Axial and Coronal
BREATH HOLD: None
I.V. CONTRAST: None (Yes for tumors)
START LOCATION:
  Axial: Bottom of maxillary sinus
  Coronal: Behind sphenoid sinus
END LOCATION:
  Axial: Through frontal sinus
  Coronal: Through frontal sinus
SLICE THICKNESS: 3-5 mm
FILMING: Soft tissue and Bone window

PARA NASAL SINUSES

PNS - CORONAL
PARA NASAL SINUSES

HEAD CT

PROTOCOLS

- BRAIN STANDARD
- PITUITARY & SELLA TURCICA
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- ORBITS
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- PARANASAL SINUSES
- TMJ
TEMBROMANDIBULAR JOINT

SCOUT: Lateral
LANDMARK: OML
SLICE PLANE: Axial and Coronal
BREATH HOLD: None
I.V. CONTRAST: None
START LOCATION: Posterior to joint
END LOCATION: Through the entire joint
SLICE THICKNESS: 1-2 mm
FILMING: Soft tissue and Bone window

TEM BROM AND IBULAR JOINT

TEM BROM AND IBULAR JOINT