BRAIN CAT SCAN
For Emergency Physicians
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Head CT

• Has assumed a critical role in the daily practice of Emergency Medicine for evaluating intracranial emergencies. (e.g. Trauma, Stroke, SAH, ICH).

• Most physicians have limited experience with interpretation.

• In many situations, the Emergency Physician must initially interpret and act on the CT without specialist assistance.
Head CT

• Most EM training programs have no formalized training process to meet this need.
• Many Emergency Physicians are uncomfortable interpreting CTs.
• Studies have shown that EPs have a significant “miss rate” on cranial CT interpretation.
WHAT IS CAT SCAN?
IT IS NOT TOTAL BODY SCAN!
CT Scan Basics

- Introduced in 1974 by Sir Jeffrey Hounsfield.
- The original “Siretom” Circa 1974

Hounsfield and Cormack: the Nobel Peace Prize
CT Scan Basics

- A CT image is a computer-generated picture based on multiple x-ray exposures taken around the periphery of the subject.
- X-rays are passed through the subject, and a scanning device measures the transmitted radiation.
- The denser the object, the more the beam is attenuated, and hence fewer x-rays make it to the sensor.
CT Scan Basics

• The denser the object, the whiter it is on CT
  – Bone is most dense = + 1000 Hounsfield U.
  – Air is the least dense = - 1000H Hounsfield U.
## HOUNSFIELD SCALE

<table>
<thead>
<tr>
<th>Tissue</th>
<th>CT Number (HU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone</td>
<td>+1000</td>
</tr>
<tr>
<td>Liver</td>
<td>40-60</td>
</tr>
<tr>
<td>White mater</td>
<td>-20 to -30</td>
</tr>
<tr>
<td>Grey mater</td>
<td>-37 to -45</td>
</tr>
<tr>
<td>Blood</td>
<td>40</td>
</tr>
<tr>
<td>Muscle</td>
<td>10-40</td>
</tr>
<tr>
<td>Kidney</td>
<td>30</td>
</tr>
<tr>
<td>CSF</td>
<td>15</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td>Fat</td>
<td>-50 to -100</td>
</tr>
<tr>
<td>Air</td>
<td>-1000</td>
</tr>
</tbody>
</table>
CT Scan Basics: Windowing

Focuses the spectrum of gray-scale used on a particular image.
Base of skull

- Brainstem
- Cerebellum
- Skull Base
  - Frontal bone
  - Sphenoid bone
  - Temporal bone
  - Occipital bone
  - Sella turcica
  - Sinuses
Plane Skull Radiography
• The intent of this session is to introduce a systematic method of cranial CT interpretation, based on the mnemonic…

**Blood Can Be Very Bad**
Head CT

Blood Can Be Very Bad
Blood Can Be Very Bad

- Blood
- Cisterns
- Brain
- Ventricles
- Bone
Blood Can Be Very Bad

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"The part of your brain you used to diagnose what is wrong with you is what is wrong with you."
Sagittal View
Brainstem Lateral View

- Circumvesecephalic Cistern
- IVth Ventricle
Sagittal View

A  Suprasellar Cistern
B  Quadrigeminal Cistern
C  Peripontine Cistern
D  Infrapontine Cistern

Cisterna Magna

Anne Olson
Cisterns at Cerebral Peduncles Level
Suprasellar Cistern
Level Sagittal View

A Suprasellar Cistern
B Quadrigeminal Cistern
C Peripontine Cistern
D Infrapontine Cistern

Cisterna Magna

Anne Olson
Cisterns at High Mid-Brain Level
B is for Blood

• 1\textsuperscript{st} decision: Is blood present?
• 2\textsuperscript{nd} decision: If so, where is it?
• 3\textsuperscript{rd} decision: If so, what effect is it having?
B is for Blood

• Acute blood is bright white on CT (once it clots)

• Blood becomes isodense at approximately 1 week.

• Blood becomes hypodense at approximately 2 weeks.
Epidural Hematoma

- Lens shaped
- Does not cross sutures
- Classically described with injury to middle meningeal artery
- Low mortality if treated prior to unconsciousness ( < 20%)
Subdural Hematoma

- Typically falx or sickle-shaped.
- Crosses sutures, but does not cross midline.
- Acute subdural is a marker for severe head injury. (Mortality approaches 80%)
- Chronic subdural usually slow venous bleed and well tolerated.
"You see, Ms. Jenkins, by doubling up on patients in the MRI, we’re able to cut costs in half, thereby passing the savings on to you."
Subarachnoid Hemorrhage
Subarachnoid Hemorrhage

- Blood in the cisterns/cortical gyral surface
  - Aneurysms responsible for 75-80% of SAH
  - AVM’s responsible for 4-5%
  - Vasculitis accounts for small proportion (<1%)
  - Acute Leukemia!
- No cause is found in 10-15%
- 20% will have associated acute hydrocephalus
CT Scan Sensitivity for SAH

- 98-99% at 0-12 hours
- 90-95% at 24 hours
- 80% at 3 days
- 50% at 1 week
- 30% at 2 weeks

➤ Depends on generation of scanner and who is reading scan.
Intraventricular/
Intraparenchymal Hemorrhage
C is for CISTERNS
(Blood Can Be Very Bad)

- 4 key cisterns
  - Circummesencephalic
  - Suprasellar
  - Quadrigeminal
  - Sylvian
Cisterns

- 2 Key questions to answer regarding cisterns:
  - Is there blood?
  - Are the cisterns open?
B is for BRAIN
(Blood Can Be Very Bad)
Hyperdense MCA sign
Tumors
Atrophy
Abscess
Stroke
Intracranial Air
(Pneumocephaly)
Pneumocephaly
Pneumocephaly
CSF Production

- Produced in choroid plexus in the lateral ventricles → Foramen of Monroe → IIIrd Ventricle → Acqueduct of Sylvius → IVth Ventricle → Lushka/Magendie
- 0.5-1 cc/min
- Adult CSF volume is approx. 150 cc’s.
- Adult CSF production is approx. 500-700 cc’s per day.
1. High pontine level
2. Cerebral peduncle level
3. Mid-brain level

Mark and Anne Olson
V is for VENTRICLES

(Blood Can Be Very Bad)
Ex-Vacuo Phenomenon
BONE
If no blood is seen, all cisterns are present and open, the brain is symmetric with normal gray-white differentiation, the ventricles are symmetric without dilation, and there is no fracture, then there is no emergent diagnosis from the CT scan.
THANK YOU