CT Scanning

Computed Tomography (CT)

• Donut Shaped machine
• Uses x-ray energy and computer generation of images
• Advantages
  – Sensitive to slight density difference
  – Cross sectional anatomy
• Attenuation: reductions in intensity of x-ray beam as it traverses matter either by absorption or deflection
• Special terms used on CT reports
  – High attenuation, Low attenuation
CT Terms

- High attenuation
  - Absorption of x-ray photon
  - Presented as white on image
- Low attenuation
  - Free passage of photon
  - Presented as black on image

CT Scanner
64+ Slice CT

- Faster scan times
- Reduced patient motion
- Increased resolution 0.35mm isotropic resolution
- 3-D reconstructions
- Improved diagnostic accuracy
- Reduced need for ‘high risk’ somewhat more invasive examinations

CT Scanner

Gantry with Rotating Tube and Detector

Patient couch or bed
Basic Principles of CT

- CT imaging system moves around the body part at a fixed location
- Attenuation information obtained in multiple planes
- Reconstruct of this attenuation information into a simple grid

Basic Principles of CT

- Each body section divided into 3 dimensional boxes – voxel
- 2 dimension grid of pixels
- Calculate attenuation in each direction
- Add up all attenuations in each pixel
- Normalize to a common scale
Basic Principles of CT

- Density of each pixel varies resulting in a pictorial representation of the density of structures within that section
- Repeat for each subsequent slice
- The smaller the slice, the higher the resolution

Spiral (Helical) CT:

- Table moves at **constant speed**
- X-ray tube and detectors **continuously rotating**
- Multiple views are acquired which are not in-plane (helical data set-volumetric data)
- Computer reconstructs views to form a slice (similar principle to that presented earlier)
Spiral (Helical) CT:

- Faster image acquisition than conventional CT (less motion artifact)
- Allows high resolution 2-D and 3-D reformations
- Isotropic Voxels
- Can also obtain conventional axial image at a single location (i.e. head CT, high resolution lung CT)
Hounsfield Units

Hounsfield units (HU) = CT Numbers =
Arbitrary scale based on attenuation with water assigned a
CT number of 0

One CT number (HU) = \( \frac{1}{1000} \) of water attenuation value

= 0.1% change in attenuation relative to water

-1,000 \rightarrow 0 \rightarrow +1,000

Air \rightarrow Water \rightarrow Dense bone

Typical CT Numbers (HU)

+1000 ------Dense Bone

Fresh Blood (+45 to +90 HU)
Liver, spleen, muscle,
Aorta, gray matter, white
matter (+25 to +75 HU)

0
CSF, cystic lesions, water

-100 \rightarrow Fat

-700 \rightarrow Lung

-1000
CT Brain Coronal MIP

CT Brain Sagittal MIP
CT Colonography

Volume CT Coronary Angiography

Three different renditions of the same data

Serial non-invasive angiography provides an opportunity to follow the effect of treatment

Courtesy Dr. Jim Potchen
CTA Coronary