Introduction to Medical Imaging

Jeff Benseler, D.O.
Objectives

- How do x-rays create an image of internal body structures?
- What are the 5 basic radiographic densities?
- Try your hand at interpreting several medical imaging cases.
List of diagnostic imaging studies

- Plain x-rays
- CT scan
- MRI
- Nuclear imaging/PET
- Ultrasound
- Mammography
- Angiography
- Fluoroscopy

Which of these modalities use ionizing radiation?
What are x-rays?

- No mass
- No charge
- Energy

What is your diagnosis?
Basic x-ray physics

- X-rays: a form of electromagnetic energy
- Travel at the speed of light
- Electromagnetic spectrum
  - Gamma Rays  X-rays
  - Visible light  Infrared light
  - Microwaves  Radar
  - Radio waves
Three things can happen

- X-rays can:
  - Pass all the way through the body
  - Be deflected or scattered
  - Be absorbed

Where on this image have x-rays passed through the body to the greatest degree?
X-rays Passing Through Tissue

- Depends on the energy of the x-ray and the atomic number of the tissue
- Higher energy x-ray - more likely to pass through
- Higher atomic number - more likely to absorb the x-ray

Diagnosis?
How do x-rays passing through the body create an image?

- X-rays that pass through the body to the film render the film dark (black)
- X-rays that are totally blocked do not reach the film and render the film light (white)
- **Air** = low atomic # = x-rays get through = image is dark
- **Metal** = high atomic # = x-rays blocked = image is light (white)
5 Basic Radiographic Densities

- Air
- Fat
- Soft tissue/fluid
- Mineral
- Metal

Name these radiographic densities.
History: “I think my dog swallowed a rock”

Diagnosis: “Yes, he did.”
Optimal Viewing

- Dedicated light source
- Darkened environment (like a movie theater)
- Limit distraction
X-ray viewing station
Diagnosis?
A broken central venous catheter has migrated into the right lower lobe pulmonary artery.
Can you recognize shapes and density?
Find the pathology
What clues do you have?
Medical Imaging

- Primary purpose is to identify pathologic conditions.

- Requires recognition of normal anatomy.
History: 11 y/o twisting injury of the foot
Please name these bones

Word bank:
Cuboid
Navicular
Medial cuneiform
Os naviculare
Naming the parts of a long bone

Word bank: epiphysis, metaphysis, diaphysis, cortex, medullary cavity
Summary: How do x-rays create an image of internal body structures?

- X-rays pass through the body to varying degrees.
- Higher atomic number structures block x-rays better, example bone.
- Lower atomic number structures allow x-rays to pass through, example: air in the lungs.

Question: If x-rays were blocked to the same degree by all body structures, could we see the internal parts of the body?
What are the 5 basic radiographic densities from black to bright white?

- Air
- Fat
- Soft tissue/fluid
- Bone/mineral
- Metal
Ways to improve your radiology skills

- The Radiology Handbook
- Learningradioiology.com
- Auntminnie.com
- Web searches with key words “medical imaging”
- Surf the websites of medical schools
What density are the lungs?

Why?

The list: air, fat, soft tissue, mineral and metal
CT scan of the abdomen

X-rays used

What density is this?

- Skin
- Air
Diagnosis?
Radiographic Analysis

- Any structure, normal or pathologic, should be analyzed for:
  1. Size
  2. Shape and contour
  3. Position
  4. Density (You must know the 5 basic densities)
The anatomical position

right

left
Absorbed

Passed through
Medullary bone

Soft tissue

Metal

Note:
Right-left marker
Technologist’s initials
Name these densities
What density is this?
Summary questions

- What 3 things when an x-ray encounters the body?
- How is it possible to see the heart on an x-ray?
- What are the 5 basic radiographic densities?
- What three things can you do to protect yourself from radiation?