Introduction To Radiology

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Objectives

OVERVIEW OF MEDICAL IMAGING.

PRINCIPLE OF EACH MODALITY

ADVANTAGES AND DISADVANTAGES OF EACH MODALITY.
Radiation

General
- From Natural environment

Medical
- Ionizing Radiation
- Non Ionizing Radiation
Medical Imaging (Radiology)

• Nearly all medical disciplines utilize medical imaging.
ALARA

As Low As Reasonably Achievable.

Principle for choosing the least hazardous examination with best diagnostic results.
Main Radiological Modalities.

- X. Ray
  - Radiograph
  - Fluoroscopy
  - DSA
  - Mammography

- Ultrasound

- C.T scan
- MRI

- Hybrid Imaging like PETC.T.
X ray

Type of ionizing radiation.

It is an electromagnetic energy.

Nearly negligible mass.

Penetrate patients body and pass to the film.
What are x-rays?

- No mass
- No charge
- Energy
Specific Imaging Modalities

Mammography:
- Low dose X ray.
- Used for breast imaging.
- Slightly different device composition.

Flouroscopy:
- Video imaging by X-Ray.

DSA:
- Digital subtraction angiography
- Eliminates bone silhouette and shows only vessels
How do x-rays passing through the body create an image?

- X-rays that pass through the body render the image dark (black)
- X-rays that are totally blocked render the image light (white)
- Air = low atomic # = x-rays get through = image is dark (black)
- Metal = high atomic # = x-rays blocked = image is light (white)
5 Basic Radiographic Densities

- Air
- Fat
- Soft tissue/fluid
- Mineral
- Metal
Optimal environment for visual perception

- Dedicated source of light (5 to 9 mega pixel monitors)
- Darkened environment (like a movie theater)
- Limit distraction
X-ray viewing station
Picture archiving and communication system is a medical imaging technology used primarily in healthcare organizations to securely store and digitally transmit electronic images and clinically-relevant reports.

The universal format for PACS image storage and transfer is DICOM (Digital Imaging And Communications in Medicine).
Can you recognize shapes and density?
Medical Imaging Interpretation

Three Basic Steps

First, learn how each modality creates an image of internal body structures.

Next, be able to accurately label normal anatomy (body structures).

Then, search for structures that don’t belong and for body structures that are abnormal in size, shape, position and/or density.
Naming the parts of a long bone

Word bank: epiphysis, metaphysis, diaphysis, cortex, medullary cavity
Review: What are the 5 basic radiographic densities from black to bright white?

- Air
- Fat
- Soft tissue/fluid
- Bone/mineral
- Metal
Summary for objective 2: 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
Objective 3
Advantages of CT, MRI and Ultrasound

These modalities are cross sectional imaging

Cross sections are like slices

X-ray studies are a 2 dimensional representation of 3 dimensional structures can result in undesirable overlapping densities and artifacts.
• **Advantages**
  - Eliminates overlapping densities
  - Excellent resolution
  - Excellent for detecting intracranial bleeding
  - Excellent in the neck, chest and abdomen
  - Excellent for evaluating fractures

• **Disadvantages**
  - More expensive than x-ray and ultrasound
  - Much more radiation
  - Dense bone (petrous ridge for example) and metal cause severe artifacts
What density is this?
MRI

- **Advantages**
  - No overlapping artifact
  - Excellent resolution
  - Very good at detecting fluid
  - Excellent for imaging the brain, spine and joints
  - No radiation
  - Multiple imaging tests within the same study (T1, T2, IR, GE)

- **Disadvantages**
  - Very expensive
  - Patients cannot have a pacemaker or ferromagnetic material
  - Slower to acquire images (approximately 45 minutes)
Ultrasound
• Advantages
  • No radiation
  • Portable
  • Instantaneous (real time)
  • Excellent for cysts and fluid
  • Doppler ultrasound is excellent to assess blood flow
  • Excellent for newborn brain, thyroid, gall bladder, female pelvis, scrotum, pregnancy

• Disadvantages
  • Does not work well in large or obese patients
  • Resolution less than CT and MRI
  • Air or bowel gas prevents visualization of structures
Ultrasound of the gall bladder showing a gall stone
X-rays, CT, MRI and ultrasound help us see into the body.

Internal body structures are composed of varied material (fat, muscle, bone, gland) or contain air, water or minerals that “show up” differently on each type of imaging test.

Each modality has its own advantages allowing us the choose the best one for each medical circumstance.
What an excellent medical student at your level can do:

- Be able to describe how x-rays can create an image of internal body structures
- Recognize and label the 5 basic densities on an x-ray
- Be familiar with the advantages for CT, for MRI and for ultrasound
THANK YOU