

Junior Radiology

Goals & Objectives

1. Short Course
2. Overview of radiology and its subspecialties
3. Lots of information
 1. Overwhelming
 2. Advanced

Goals & Objectives

Attend lectures & Listen

1. Attempt to learn at least one new principle
2. Do not worry about the final exam
 1. Written
 2. Practical
3. Pay attention & you will pass with 100%



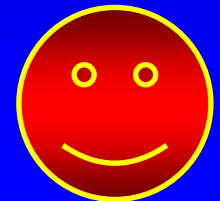
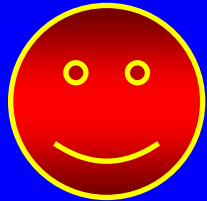
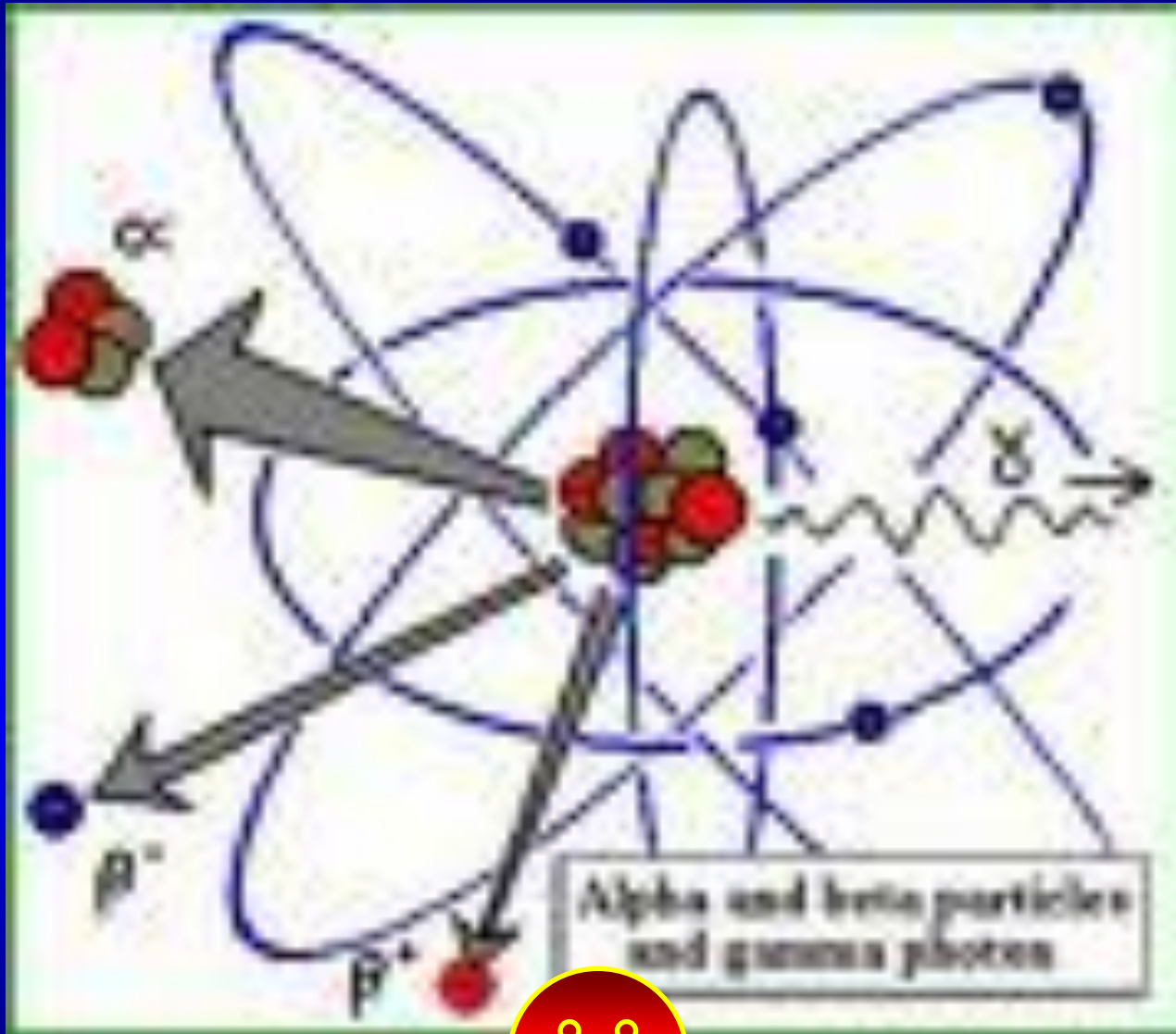
- Learning Radiology textbook
- <http://www.learningradiology.com/>

Goals & Objectives

1. Course Evaluation:

1. Important
2. We listen to what you want
3. Please take your time to complete

Radiology



Diagnostic

Therapeutic

Diagnostic Radiology



Subspecialties

Emergency
Radiology

Chest/Pulmonary

Pediatric

Abdominal Imaging
Gastroenterology
Genitourinary

Musculoskeletal

Vascular & Interventional

Cardiac

Neuroradiology

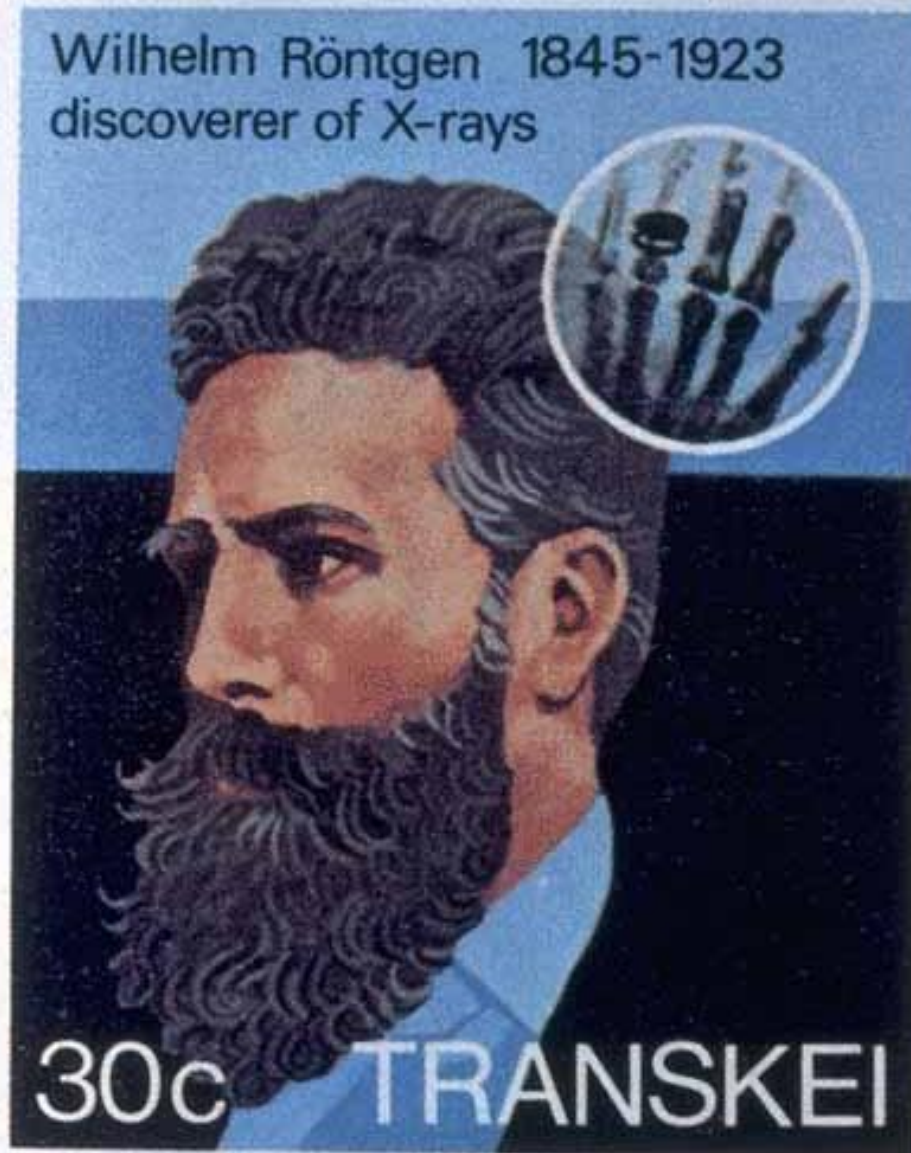
Nuclear Medicine

Ultrasound

Mammography

“Must See” diagnoses for medical students

- ① Pneumoperitoneum: perf. viscus
- ② Pyelonephritis “striate”/abscess
- ③ Cholelithiasis vs. Cholecystitis
- ④ Appendicitis (CT preferred)
- ⑤ Diverticulitis (LLQ pain)
- ⑥ Ischemic Colitis can get pneumotosis coli/ PV intrahep air
- ⑦ Hemorrhage= Leaking aneurysm



1895:

**Roentgen
discovers**

X-rays

**(by
accident)**

**[www.xray.hm
c.psu.edu/rci/
centennial.htm](http://www.xray.hm.c.psu.edu/rci/centennial.htm)**

!

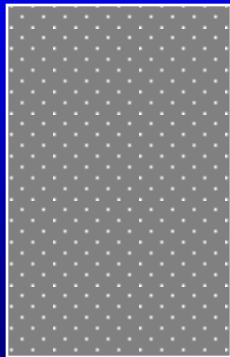
What is an X-ray?

- X-rays are very **short wavelength** electromagnetic radiation. Shorter wavelength, greater energy/greater the ability to **penetrate matter**
- X-rays are described as packets of energy called Quanta or **Photons**
- **Photons travel at the speed of light**
- **Photon energy measured in Electron Volts**

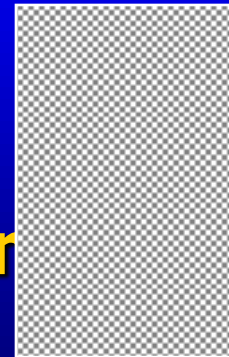
X-ray beam

absorption and attenuation

- X-Rays passing through matter become **ATTENUATED** via absorption and scatter.
- For a given thickness, the greater the physical density (gm/cc) of a material, the greater its ability to absorb or scatter X-Rays.

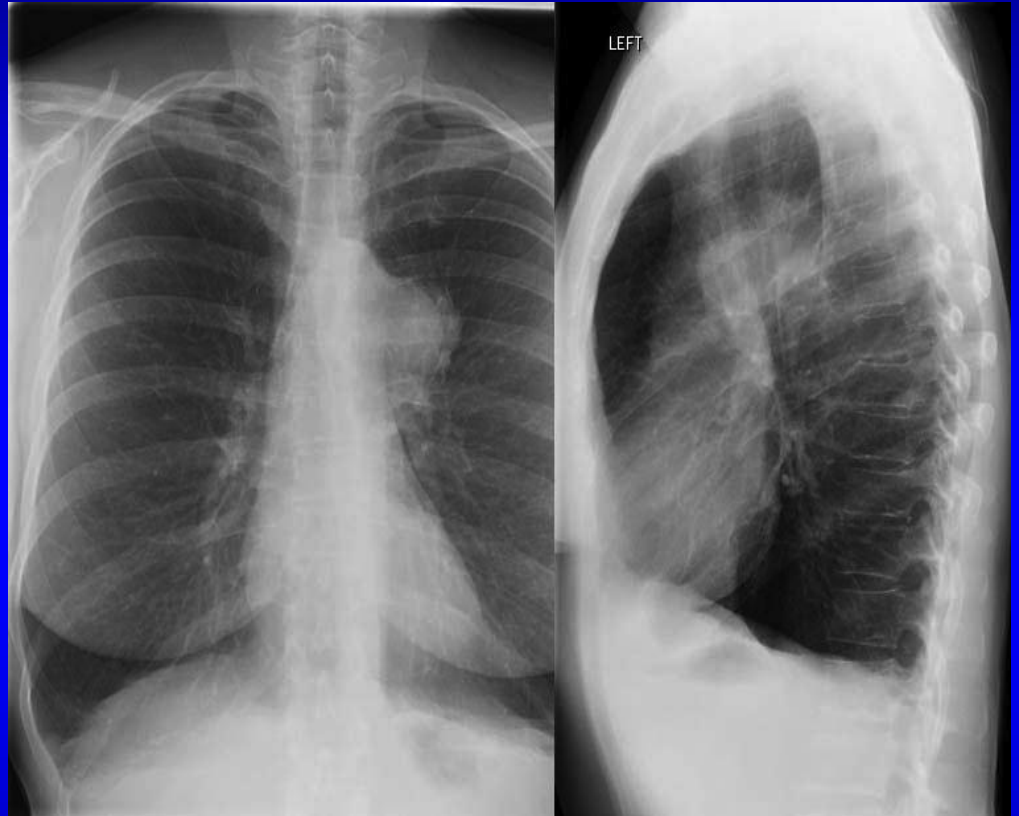


Lead > Aluminum



More photons
strike the film
⇒ film appears
BLACKER

Fewer photons
strike the film
=> film appears
whiter



X-ray beam absorption and attenuation

- X-Rays passing through matter become **ATTENUATED** via absorption and scatter
- With increasing atomic number comes increasing attenuation by the material

Radiographic Densities

■ Metal	Very White
■ Bone	White
■ Water	Gray
■ Fat	Gray-Black
■ Air	Black

Metal is most Radiodense or Radiopaque

Air is most Radiolucent

Hounsfield Unit Scale (CT Attenuation)

■ Gas (Air)	-1,000 HU
■ Fat	-100 HU
■ Water	0 HU
■ Soft tissue	+20 to +100 HU
■ Bone	+1,000 HU

Ionization

- An atom which loses an electron is ionized
- Photons having \geq **15** electron volts can produce ionization in atoms and molecules
- X-Rays, Gamma Rays, and certain types of UV Radiation are Ionizing Radiation

LIMITING YOUR EXPOSURE:

You do the math!

- Doubling your distance from the X-ray tube reduces your exposure by a factor of four
- Tripling your distance from the X-ray tube reduces your exposure by a factor of nine!

RadTech uses collimation and lead apron to **reduce exposure**

Ionizing Radiation in Radiology

- Patients undergoing these types of studies are exposed to Ionizing Radiation:
 - Radiographs
 - Fluoroscopy/Conventional Angiography
 - **CT**
 - Nuclear Medicine

Multi-Detector (Helical) CT

multiple planes of detectors in the gantry

- Technical innovation allows
 - even faster scanning
 - over a much longer range
 - with even better image quality
- Radiation exposure greater than single-detector CT
- “Total body” CT in trauma pts

Helical CT: A volumetric examination

synonym:

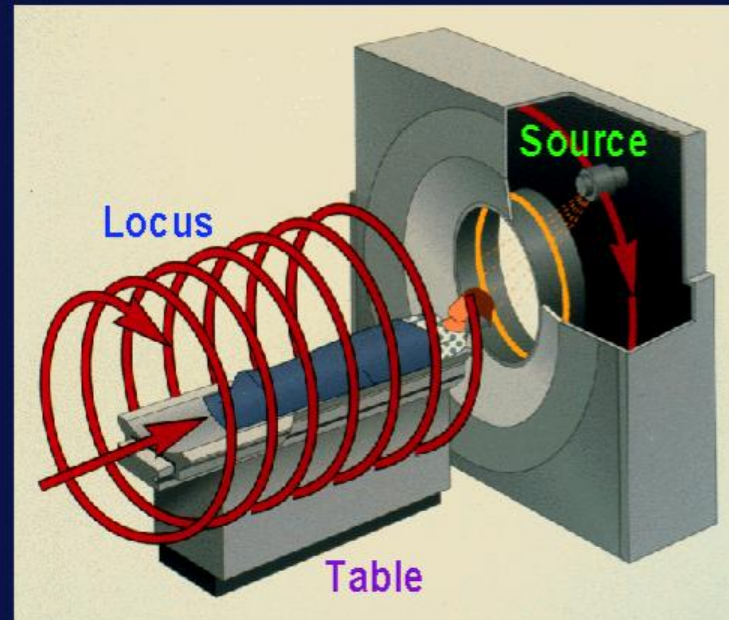
Tube and table move:

Tube: circular path

Table: translocation

CT computer creates discrete images from this volume of data

Spiral/Helical CT as a Linear System



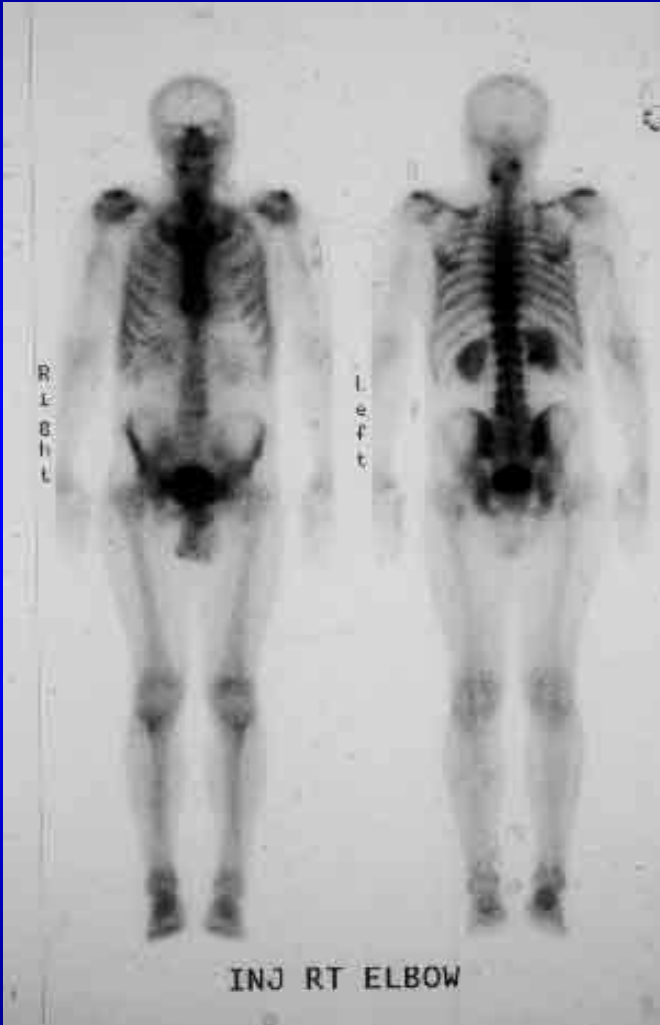
MAIN ADVANTAGES OF CT OVER MRI

- Rapid scan acquisition
- Visualization of **cortical bone** and soft tissue **calcifications**

Exposure to Ionizing Radiation causes two types of effects

- **Deterministic Effects:** A **minimum threshold** dose must be attained for the effect to occur. Examples include cataract formation, skin reddening (erythema), and sterility. Also referred to as “**non-stochastic**” effects
- **Stochastic** Effects: The effect may (potentially) occur following **any amount** of exposure – there is no threshold. Examples include **cancer and genetic defects.**

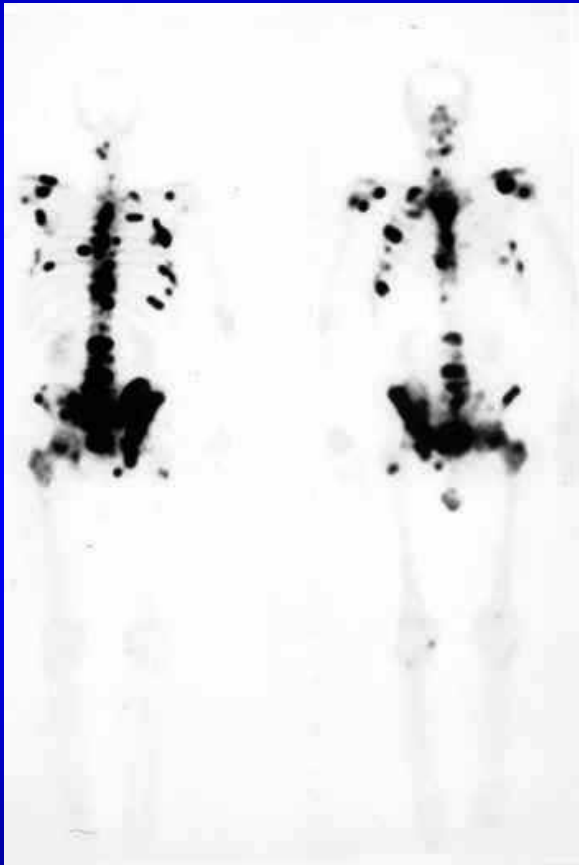
Normal bone scan



Anterior

Posterior

mets



Posterior

Anterior

Nuclear Medicine

- **Photons** emitted by radioisotopes are detected by Sodium Iodide crystals. Brightness of light emitted depends on the **energy of the photon**
- **Photodetectors** convert the light into an electronic signal, which a computer converts to diagnostic images.....

Nuclear Medicine

- Most imaging modalities detect changes in gross **anatomy**
- However, most NM exams rely on changes in **physiology** to detect disease.
- Radionuclides
 - Produce **ionizing radiation**
 - Administered I.V., orally, SubQ

PACS Training

- Picture Archiving and Communication System
- Digital system for storage, retrieval, and display of imaging studies
- ILH is completely filmless =PACS is your only access to your patients' images
- Therefore, you are encouraged to learn to use PACS

Contrast Media

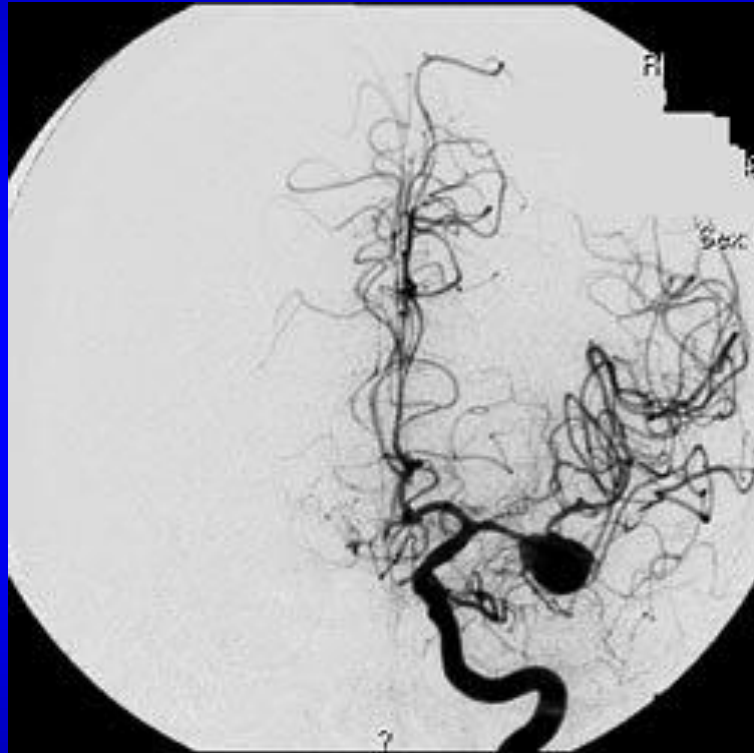
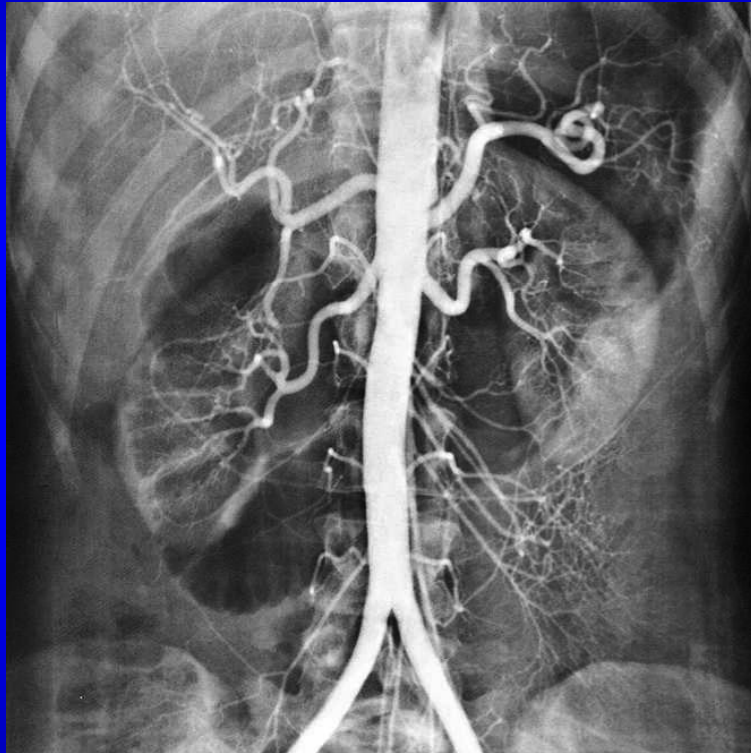
- Most viscera are of water-density or close to it
- Contrast media are materials we introduce to better define anatomy and pathologic changes

Barium enema

[www.philips.com/
Main/products/xray/
Assets/images/dose
Wise/urf2_large.jpg](http://www.philips.com/Main/products/xray/Assets/images/doseWise/urf2_large.jpg)



Angiography uses intravenous contrast medium



Iodinated Contrast

Reactions

Mild Warmth, metallic taste, N/V, HA, Dizziness, Tachycardia, sneezing, coughing, erythema,

Moderate Agitation, bradycardia, hypotension, wheezing, urticaria (“hives”), itching

Severe Pulm edema, shock, CHF, cardiac arrest, laryngospasm, laryngeal edema, apnea, seizure, coma

Common Indications for IV Contrast in CT

- To visualize **blood vessels**
(Aortic injury, Abdominal Aortic Aneurysm, Pulmonary Embolus)
- To evaluate for primary or metastatic **tumor**
- To evaluate for **infection** or **inflammatory** processes
- To evaluate for **traumatic** injury

CT

- Contrast resolution far superior to plain radiographs, but spatial resolution inferior to XR
- Thinly collimated x-ray beam passes through a “slice” of the patient’s body while the x-ray tube moves in an arc around the patient
- Electronic detectors, placed opposite the x-ray tube, convert the attenuated x-ray beam into electrical pulses. Computers convert this data to a gray-scale image

MRI Contrast

Media

■ Gadolinium

- Paramagnetic (radiopaque)
- IV
- NSF/ check GFR=renal function