INTRODUCTION AND OVERVIEW

Dr. Mahmoud S Dahoud

Radiology Equipment Technician I (X-Ray)

Fall semester

Week 1

Date Oct 7th 2025

Outline

- Introduction and Overview
  - X-ray
  - Portable x-ray
  - CT-scan
  - Mammography
  - Flouroscopy

Objectives

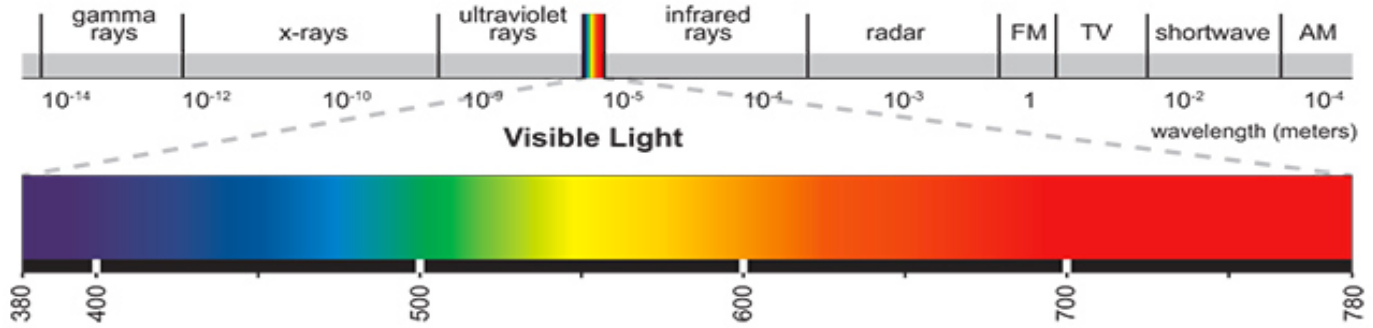
The student should be able to do the followings;

- Define x-ray
- Classify the x-ray machines to portable and conventional devices
- Compare between x-ray and visible light
- Mention the use and properties of CT scan
- Describe the procedures for fluoroscopy
- Compare the two types of Mammography

What's an X-Ray?

X-rays are basically the same thing as visible light rays. Both are wavelike forms of **electromagnetic energy** carried by particles called photons. The difference between X-rays and visible light rays is the **energy level** of the individual photons. This is also expressed as the **wavelength** of the rays.

WHEN FAST-MOVING electrons slam into a metal object, x-rays are produced. The kinetic energy of the electrons is transformed into electromagnetic energy. The function of the x-ray imaging system is to provide a controlled flow of electrons intense enough to produce an x-ray beam appropriate for imaging. The three main components of an x-ray imaging system are (1) the operating console, (2) the x-ray tube, and (3) the high-voltage generator.



Portable X-Ray

- **Portable radiography** (also known as **mobile radiography**) is frequently performed in hospitals when patients are too unwell to transport to the imaging department.

Portable X-Ray

Tips for portable radiography

◦planning how to x-ray the patient before moving the patient will keep the patient comfortable for as long as possible, thus may increase patient compliance ensure that surrounding staff and patients are not pregnant; if a nearby patient is pregnant, staff will need to move them away temporarily.

◦advise all staff and patients to stand as far away as possible during exposure as doubling the distance will halve the scattered radiation dose before making an exposure, always produce an audible alert (i.e. "X-ray, Bed number _") to ensure all staff and patients nearby know an x-ray is about to be performed to maintain infection control, pillowcases or plastic bags can be used to cover the detector, and sanitiser wipes used to clean the equipment in between patients

video

CT Scan

◦Computed tomography is commonly referred to as a CT scan

◦A CT scan is a diagnostic imaging exam that uses x-ray technology to produce images of the inside of the body.

◦A CT scan can show detailed images of any part of the body, including the bones, muscles, organs and blood vessels.

◦CT scans can also be used for fluid or tissue biopsies, or as part of preparation for surgery or treatment.

◦CT scans are frequently done with and without contrast agent to improve the radiologist's ability to find any abnormalities.

- CT scans may be done with or without contrast. Contrast refers to a substance taken by mouth or injected into an IV line that causes the particular organ or tissue under study to be seen more clearly. Contrast examinations may require you to fast for a certain period of time before the procedure.
- The amount of radiation dose used in a CT scan is small.

video

CT scans follow this process

- The patient will lie on a scan table that slides into a large, circular opening of the scanning machine.
-The technologist will be in another room where the scanner controls are located. However, the patient will be in constant sight of the technologist through a window.
- As the scanner begins to rotate around the patient, X-rays will pass through the body for short amounts of time.
- The X-rays absorbed by the body's tissues will be detected by the scanner and transmitted to the computer. The computer will transform the information into an image to be interpreted by the radiologist.
- If contrast media is used for patient's procedure, who may feel some effects when the contrast is injected into the IV line. These effects include a flushing sensation, a salty or metallic taste in the mouth, a brief headache, or nausea and/or vomiting. These effects usually last for a few moments.
- If an IV line was inserted for contrast administration, the line will be removed.

Advances in CT technology include:

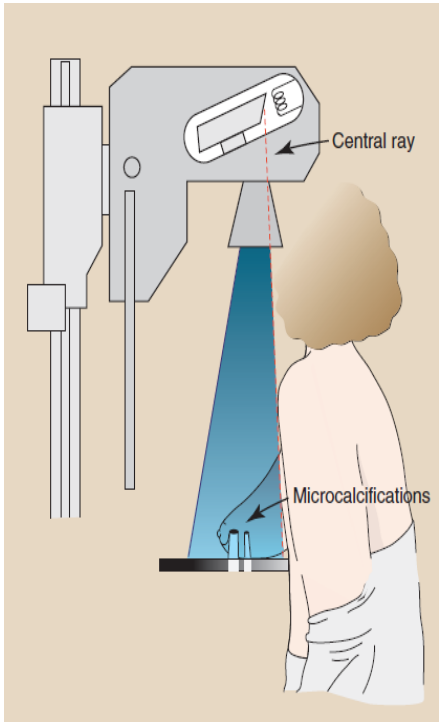
- High-resolution CT: This type of CT scan uses very thin slices (less than 0.1 inches), which are effective in providing greater detail in certain conditions, such as lung disease.
- Helical or spiral CT: During this type of CT scan, both the patient and the X-ray beam move continuously, with the X-ray beam circling the patient. The images are obtained much more quickly than with standard CT scans. The resulting images have greater resolution and contrast, providing more detailed information. Multidetector-row helical CT scanners may be used to obtain information about calcium buildup inside the coronary arteries of the heart.

Mammography

BASIS FOR MAMMOGRAPHY

The principal motivation for the continuing development and improvement of mammography is the high incidence of breast cancer. Until recently, breast cancer had been the leading cancer in women.

Unfortunately, lung cancer has surpassed breast cancer as the leading cause of cancer deaths in women, possibly because of the increasing use of tobacco, but certainly because of the success of early detection using x-ray mammography.



Mammography

Types of Mammography

Two different types of mammographic examination are conducted.

1- Screening mammography is performed on asymptomatic women with the use of a two-view protocol, usually medial lateral oblique and cranial caudad, to detect an unsuspected cancer.

2- Diagnostic mammography is performed on patients with symptoms or elevated risk factors. Two or three views of each breast may be required. Because the mass density and atomic number of soft tissue components of the breast are so similar, conventional radiographic technique is useless. In the 70- to 100-kVp range, Compton scattering predominates with soft tissue; thus, differential absorption within soft tissues is minimal. Low kVp must be used to maximize the photoelectric effect and thereby enhance differential absorption and improve contrast resolution.

Mammography

x-ray absorption in tissue : This occurs principally by photoelectric effect and Compton scattering. The degree of absorption is determined by the tissue mass density and the effective atomic number. Absorption caused by differences in mass density is simply proportional to the mass density for both photoelectric effect and Compton scattering. Absorption caused by differences in atomic number, however, is directly proportional for Compton scattering and proportional to the cube of the atomic number for photoelectric effect. Therefore x-ray mammography requires a low-kVp technique. As kVp is reduced, however, the penetrability of the x-ray beam is reduced, which in turn requires an increase in mAs. If the kVp is too low, an inordinately high mAs value may be required, which could be unacceptable because of the increased patient radiation dose. Technique factors of approximately 23 to 28 kVp are used as an effective compromise between the increasing dose at low kVp and reduced image quality at high kVp.

Mammography

Filtration

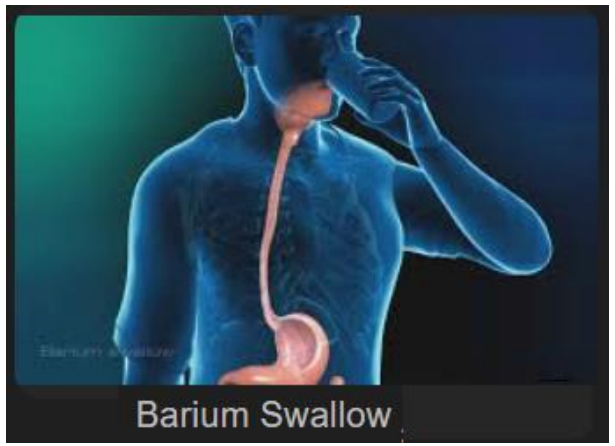
At the low kVp used for mammography, it is important that the x-ray tube window not attenuate the x-ray beam significantly. Therefore dedicated mammography x-ray tubes have either a beryllium (Z = 4) window or a very thin borosilicate glass window.

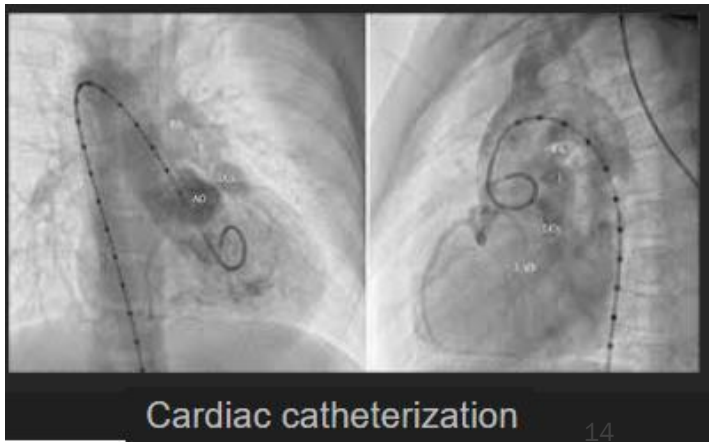
Most mammography x-ray tubes have inherent filtration in the window of approximately 0.1 mm Al equivalent. Beyond the window, the proper type and thickness of x-ray beam filtration must be installed. If a tungsten target x-ray tube is used, it should have a molybdenum or rhodium filter. The purpose of each filter is to reduce the higher-energy bremsstrahlung x-rays.

Fluoroscopy

Fluoroscopy is a form of medical imaging that uses a series of X-rays to show the inside of your body in real time, like a video. Healthcare providers use it to diagnose conditions and to help guide medical procedures. Common examples of fluoroscopy include angiography, barium swallow, cardiac catheterization and stent or catheter placement. fluoroscopy gets images of what your body's doing as it happens.

Angiogram Test





Fluoroscopy

How does fluoroscopy work?

Fluoroscopy works by using a special camera that uses pulses (brief bursts) of X-ray beams to take pictures of patient insides. This can be while the organs perform their normal tasks or while the provider performs a procedure. Some procedures use a contrast agent to help the provider see your organs and structures better.

References

- Bushong S. C., . (2017). *Radiologic science for technologists*. St. Louis, Missouri: Elsevier.
- Guy C. and Ffytche D. (2005). *An Introduction to The Principles of Medical Imaging*. Imperial College Press
- Hendee W., and Ritenour E.,. (2002). *Medical Imaging Physics*. Willy-Liss,Inc