Occupational Radiation Exposure

Third Lecture (3)

First semester / Second year

By

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Occupational Radiation Exposure in:

Fluoroscopy:

Fluoroscopy: is an imaging technique that uses X-Rays to obtain real-time moving images of the movements that occur inside a part of the body. In its medical application of imaging, it allows a surgeon to see the internal structure and function of a patient so that the pumping action of the heart or the motion of swallowing, for example, can be watched. Figure 1 shows the fluoroscopy device.

Figure (1): Shows the Fluoroscopy device.

Mechanism of the Fluoroscopy:

The classic fluoroscopy device achieves radiography by fluorescence, in which certain materials convert X-Ray energy into visible light. This use of fluorescent materials to make a viewing scope is how fluoroscopy got its name. A continuous X-Ray beam is passed through the body part being examined. The beam is transmitted to a TV-like monitor so that the body part and its motion can be seen in detail. Fluoroscopy is an imaging tool that enables physicians to look at many body systems, including the skeletal, digestive, urinary, respiratory, and reproductive systems.

A fluoroscope consists of: An X-Ray source and a fluorescent screen, between which a patient is placed. Figure 2 is a diagram of the components and mechanism of a typical fluoroscopy unit.

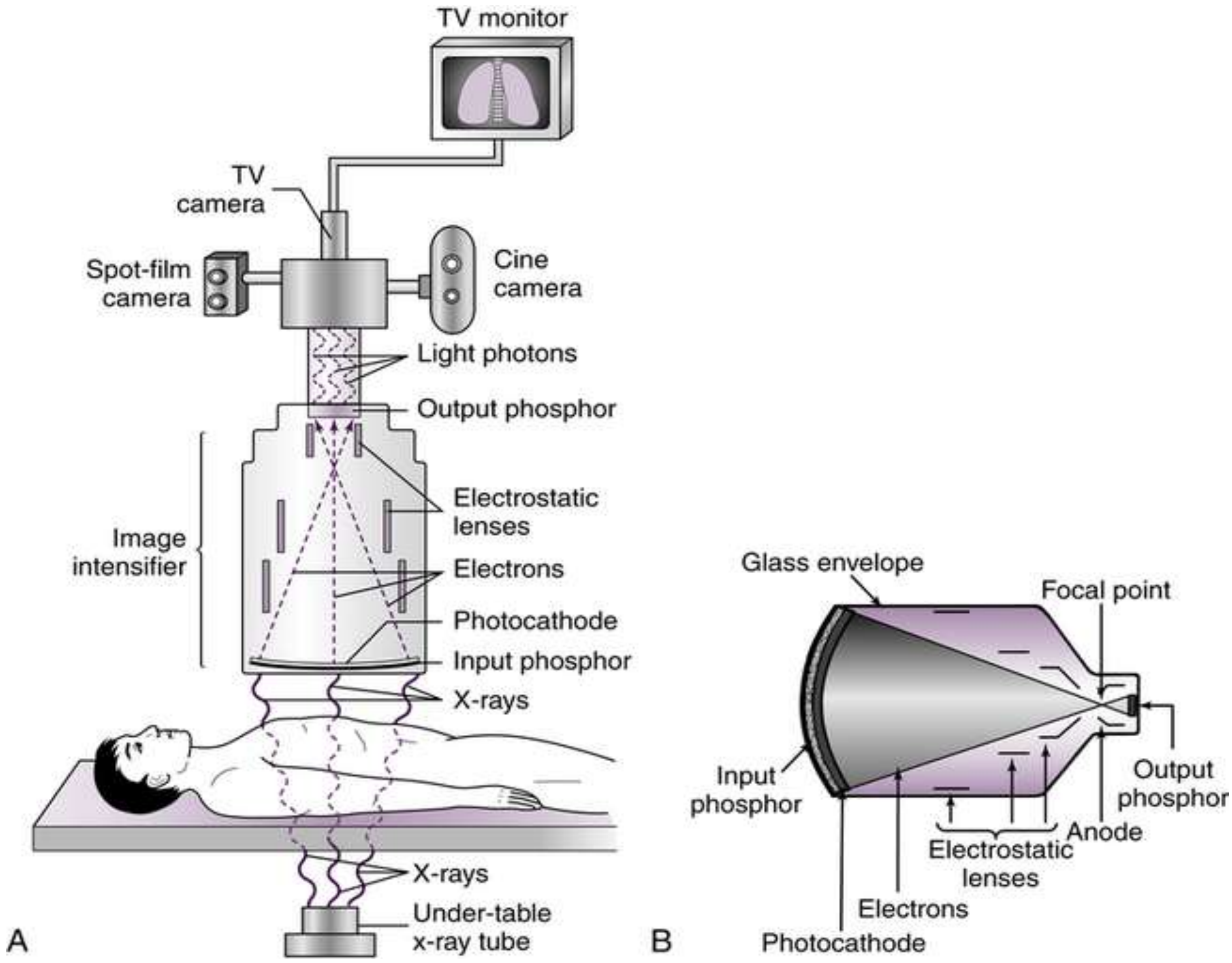

Figure (2): Diagram of the components and mechanism of a typical fluoroscopy unit.

Benefits:

Fluoroscopy is used in a wide variety of examinations and procedures to diagnose or treat patients. Some examples are:

- Barium X-rays and enemas **(to view the gastrointestinal tract).**
- Catheter insertion and manipulation **(to direct the movement of a catheter through blood vessels, bile ducts, or the urinary system).**
- Placement of devices within the body, such as stents **(to open narrowed or blocked blood vessels).**
- Angiograms **(to visualize blood vessels and organs).**
- Orthopedic surgery **(to guide joint replacements and the treatment of fractures).**

Risks:

While fluoroscopy itself is not painful, the procedure being performed may be painful, such as the injection into a joint or accessing an artery or vein for angiography. The radiologist will take all comfort measures possible, which could include local anesthesia, or general anesthesia, depending on the procedure. Some examples are:

i. Radiation-induced cancers, which may occur sometime later in life.
ii. Contrast dye, if used, can produce an allergic reaction in some people.
iii. Radiation-induced injuries to the skin and underlying tissues such as burns and hair loss occur shortly after the exposure. Figure 3 shows the fluoroscopy burn from long exposure.

Figure (3): Shows the Fluoroscopy burn from long exposure.

Mammography:

Mammography: is an X-Ray imaging method used to examine the breast for the early detection of cancer and other breast diseases. It is used as both a diagnostic and screening tool. Figure 4 shows the mammography device.

Figure (4): Shows the Mammography device.

NOW, how does Mammography work?

Answer: During a mammogram, a patient's breast is placed on a flat support plate and compressed with a parallel plate called a paddle. An X-Ray machine produces a small burst of x-rays that pass through the breast to a detector located on the opposite side. The detector can be either a photographic film plate, which captures the X-Ray image on film, or a solid-state detector, which transmits electronic signals to a computer to form a digital image. The images produced are called ***"mammograms".***

On a film mammogram, low-density tissues, such as fat, appear translucent (i.e., darker shades of gray approaching the black background), whereas areas of dense tissue, such as connective and glandular tissue or tumors, appear whiter on a gray background, as shown in figure 5. In a standard mammogram, both a top and a side view of each breast are taken, although extra views may be taken if the physician is concerned about a suspicious area of the breast. Figure 5 shows how the mammography works.

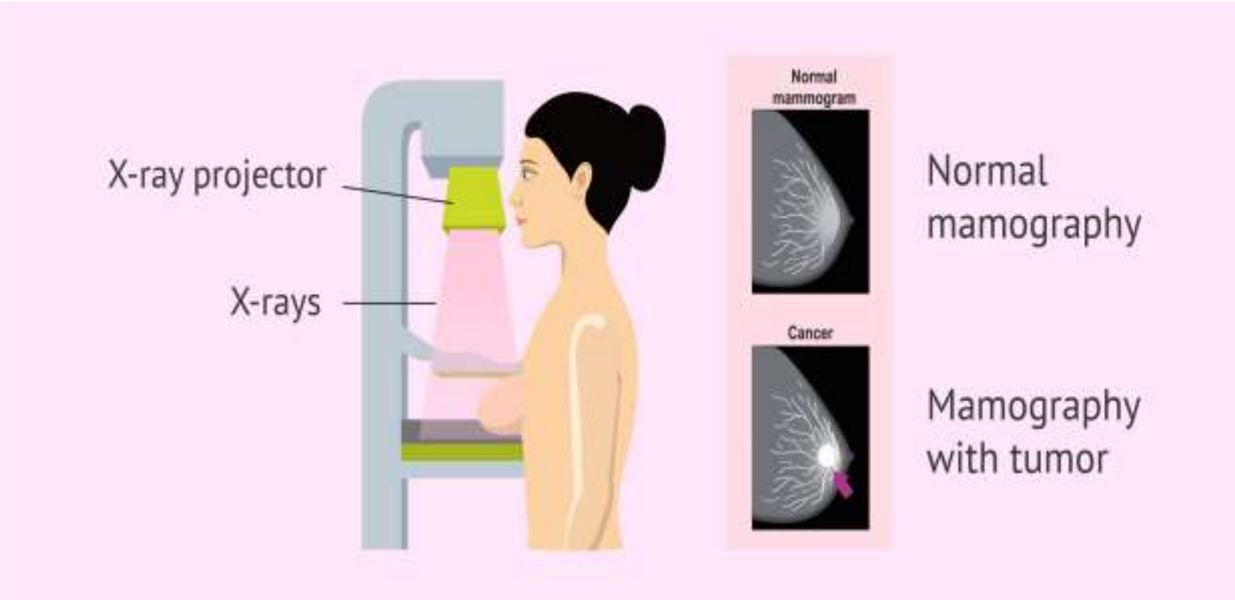

Figure (5): Shows how the Mammography works.

Quastion: Are Mammograms Safe?

Answer: Yes, mammograms are absolutely safe and have a low radiation dose. The benefits of early breast cancer detection through mammography typically outweigh the potential risks associated with radiation exposure.

Computed Tomography (CT) scanner:

A Computed Tomography (CT) scanner: Figure 6 shows the Computed Tomography scanner. It's a medical imaging technique used to obtain detailed internal images of the body. It's also based on the capability of different tissues to absorb X-Rays. A CT imaging system produces cross-sectional images of anatomy. The cross-sectional images are used for a variety of diagnostic and therapeutic purposes, as shown in figure 7.

Figure (6): Shows the Computed Tomography (CT) scanner.

Figure (7): Cross-sectional image of abdomen.

NOW, how does a CT scanner work?

Answer: In CT, the X-Ray beam moves in a circle around the body. This allows many different views of the same organ or structure and provides much detail. The X-Ray information is sent to a computer that interprets the X-Ray data and displays it in two-dimensional form on a monitor. Newer technology and computer software make three-dimensional images possible.

NOTE: CT is similar to Radiography and Fluoroscopy in that it generates images using X-Rays. The original difference was that radiography fixed still images on film, whereas computed tomography and fluoroscopy provided live, moving pictures that were not stored. But these days, digital imaging modalities like radiography, CT, and fluoroscopy all have image processing tools and data storage and retrieval capabilities.

Benefits:

A CT used in a wide variety of examinations and procedures to diagnose patients. Some examples are:

- Diagnose muscle and bone disorders, such as bone tumors and fractures.
- Pinpoint the location of a tumor, infection, or blood clot.
- Guide procedures such as surgery, biopsy, and radiation therapy.
- Detect and monitor diseases and conditions such as cancer, heart disease, lung nodules and, liver masses.
- Monitor the effectiveness of certain treatments, such as cancer treatment.
- Detect internal injuries and internal bleeding.

Quastion: Are CT scans Safe?

Answer: During a CT scan, you're briefly exposed to ionizing radiation. The amount of radiation is greater than you would get during a plain X-Ray because the CT scan gathers more detailed information. The low doses of radiation used in CT scans have not been shown to cause long-term harm, although at much higher doses, there may be a small increase in your potential risk of cancer. A CT scan has many benefits that outweigh any small potential risk. Doctors use the lowest dose of radiation possible to obtain the needed medical information. Also, newer, faster machines and techniques require less radiation than were previously used. Table 1 shows radiation dose comparisons.

Table (1): Radiation Dose Comparisons.

Diagnostic Procedure	Typical Effective Dose (mSv)[1]
Chest X-Ray (PA film)	0.02
Lumbar Spine	1.5
I.V. Urogram	3
Upper G.I. Exam	6
Barium Enema	8
CT Head	2
CT Chest	7
CT Abdomen	8
Coronary Artery Calcification CT	3
Coronary CT Angiogram	16