FLOUROSCOPY

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Radiology Equipment Technician I (X-Ray)

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Week 9

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Outline

- Flouroscopy
- Traditional image system
- Film apparatus
- Image intensification
- Digital fluoroscopy
- Digital subtraction angiography

Objectives

The student should be able to do the followings;

- Explain fluoroscopy
- Traditional image system
- Film apparatus
- Image intensification
- Digital fluoroscopy
- Digital subtraction angiography

FLUOROSCOPY

- The primary function of the fluoroscope is to provide real-time **dynamic** viewing of anatomic structures.
- It shows the motion of circulation or the motion of internal structures.
- During fluoroscopy, the radiologist often uses contrast media to highlight the anatomy.
- The fluoroscope is used for examination of moving internal structures and fluids.
- The x-ray tube is usually hidden under the patient couch, and the image intensifier or other image receptors are set over the patient couch.
- During image-intensified fluoroscopy, the radiologic image is displayed on a television monitor or flat panel monitor.
- During fluoroscopy, the x-ray tube is operated at less than 5 mA.
- The patient dose is considerably higher during fluoroscopy than during radiographic examinations because the x-ray beam exposes the patient continuously for a considerably longer time.

FLUOROSCOPIC TECHNIQUE

- **Automatic brightness control (ABC):** Fluoroscopic equipment allows the radiologist to select an image brightness level that is subsequently maintained automatically by varying the kVp, the mA, or sometimes both depends entirely on the section of the body that is being examined.
- The brightness of the fluoroscopic image depends primarily on the anatomy that is being examined, the kVp, and the mA. The patient's anatomy cannot be controlled by the radiologic technologist; however, fluoroscopic kVp and mA can be controlled.
- Generally, high kVp and low mA are preferred.
- Table 25-1 presents representative fluoroscopic kVp values for several common examinations. The fluoroscopic mA is not given because this value varies according to patient thickness and the response of the ABC system.

TABLE 25-1 Representative Fluoroscopic and Spot-Film kVp for Common Examinations

Examination	kVp
Gallbladder	65–75
Nephrostogram	70–80
Myelogram	70–80
Barium enema (air contrast)	80–90
Upper gastrointestinal	100–110
Small bowel	110–120
Barium enema	110–120

IMAGE INTENSIFICATION

- Image-Intensifier Tube: is an electronic device that receives the image-forming x-ray beam and converts it into a visible-light image of high intensity.
- X-rays that exit the patient and are incident on the image-intensifier tube are transmitted through the glass envelope and interact with the input phosphor, which is cesium iodide (CsI). When an x-ray interacts with the input phosphor, its energy is converted into visible light.
- Each photoelectron that arrives at the output phosphor produces 50 to 75 times as many light photons as were necessary to create it.
- The brightness gain of most image intensifiers is 5000 to 30,000, and it decreases with tube age and use.

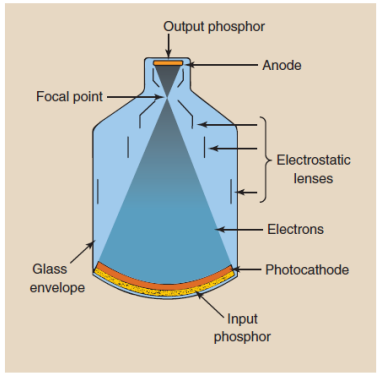

FIGURE 25-4 The image-intensifier tube converts the pattern of the x-ray beam into a bright visible-light image.

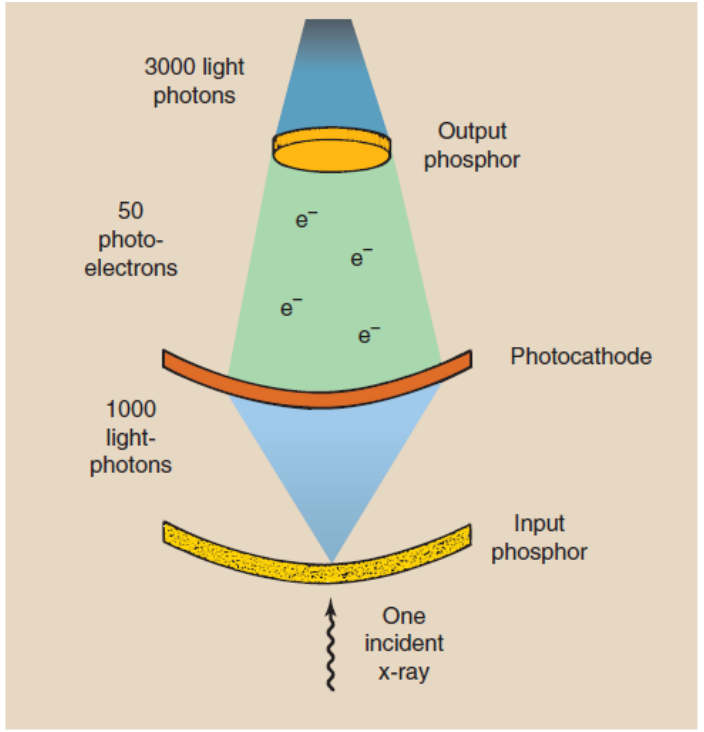

FIGURE 25-6 In an image-intensifier tube, each incident x-ray that interacts with the input phosphor results in a large number of light photons at the output phosphor. The image intensifier shown here has a flux gain of 3000.

IMAGE INTENSIFICATION

- Multifield Image Intensification: produces different magnification of the image and provides considerably greater flexibility in all fluoroscopic examinations.
- This increase in patient radiation dose results in better image quality.
- It allows the operator to electronically change the field of view (FOV)

of an image intensifier, typically by increasing the voltage to the focusing lenses to select a smaller input area for magnification, which sharpens details (improves spatial resolution) but increases patient radiation dose, offering a crucial trade-off between seeing small structures better and dose management

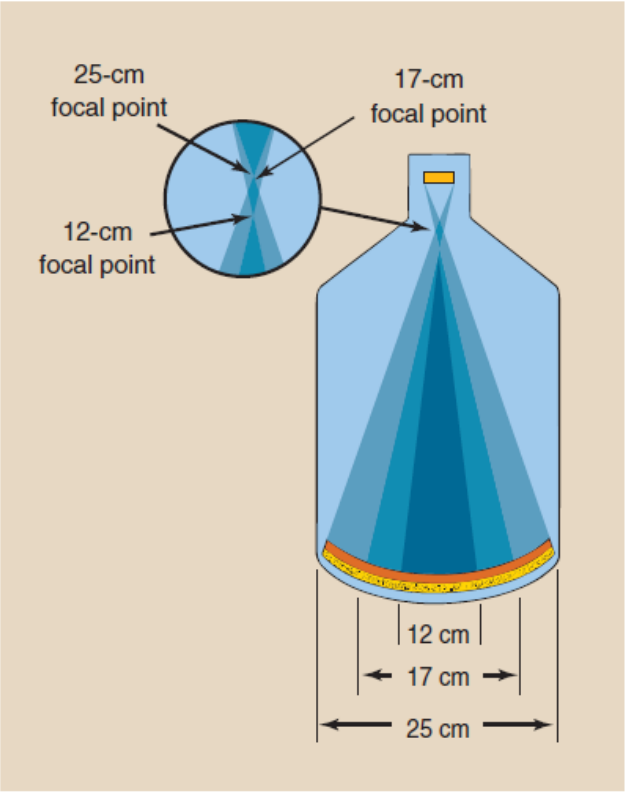

FIGURE 25-9 A 25/17/12 image-intensifier tube produces a highly magnified image in 12-cm mode.

FLUOROSCOPIC IMAGE MONITORING

1- Television Monitoring: The television camera tube converts the light image from the output phosphor of the image intensifier into an electrical signal that is sent to the television monitor, where it is reconstructed as an image on the television screen and has a high brightness.

A television camera tube or CCD converts the light signal from the output phosphor to an electronic signal..

2-Image Recording: The conventional **cassette-loaded spot film** is one item that is used with image-intensified fluoroscopes. The spot film is positioned between the patient and the image intensifier .

- The **photospot camera** is similar to a movie camera except that it exposes only one frame when activated. It receives its image from the output phosphor of the image-intensifier tube and therefore requires less patient exposure than is required by the cassette-loaded spot film.

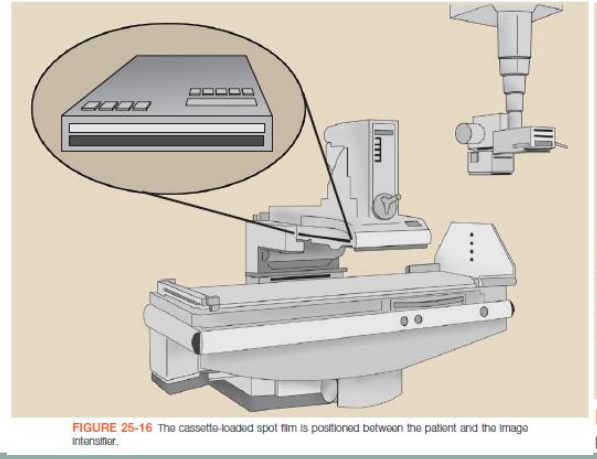

FIGURE 25-16 The cassette-loaded spot film is positioned between the patient and the image intensifier.

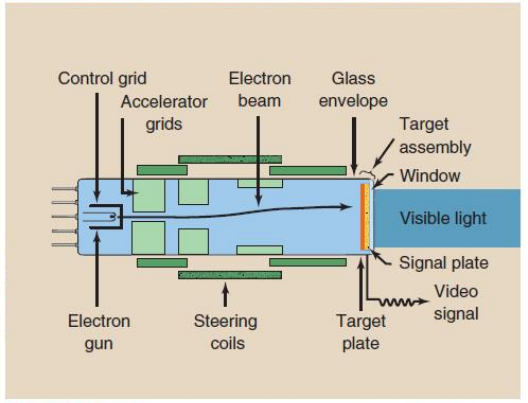

FIGURE 25-11 Vidicon television camera tube and its principal parts.

TRADITIONAL IMAGE SYSTEM

- Conventional fluoroscopy produces a shadowgraph-type image on a receptor that is directly produced from the transmitted x-ray beam. Image-intensifier tubes serve as the fluoroscopic image receptor. These tubes usually are coupled electronically to a television monitor for remote viewing,
- Digital fluoroscopy (DF) is a digital x-ray imaging system that produces dynamic images obtained with an area x-ray beam. The difference between conventional fluoroscopy and DF is the nature of the image and the manner in which it is digitized.
- Advantages of DF over conventional fluoroscopy include the speed of image acquisition and postprocessing to enhance image contrast.

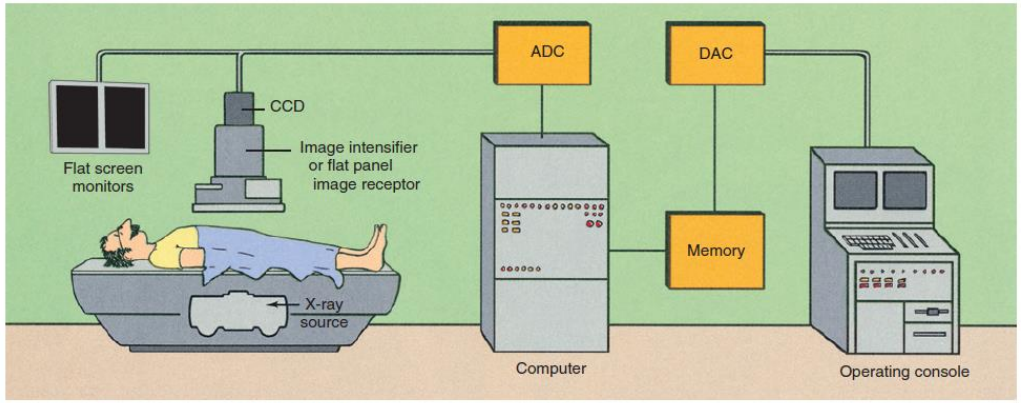

FIGURE 26-2 The components of a digital fluoroscopy imaging system.

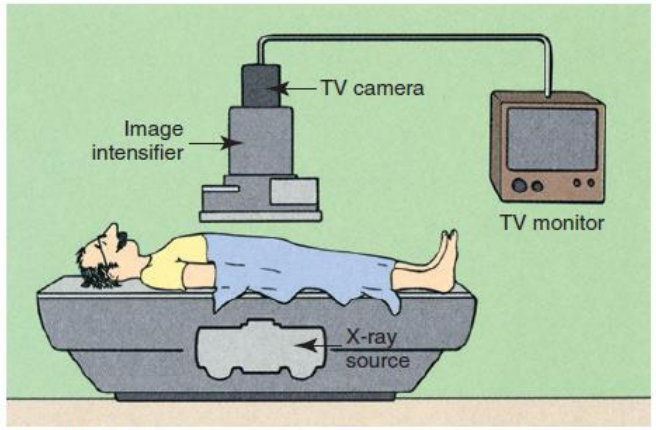

FIGURE 26-1 The imaging chain in conventional fluoroscopy.

FILM APPARATUS

A fluoroscopy film apparatus is an older or specialized x-ray system that captures still images (like traditional radiography) from a real-time fluoroscopic video, using an x-ray source, a fluorescent screen, and a spot film device (often with a cassette holder) to record images onto photographic film, often in a series or "spot film" for documentation, though modern systems use digital capture. Key parts include the X-ray tube, image intensifier (or direct screen), and a mechanism to insert film cassettes, providing a snapshot of the live X-ray view.

Digital Fluoroscopy

- During DF, the under-couch x-ray tube actually operates in the radiographic mode. Tube current is measured in hundreds of mA instead of less than 5 mA, as in image-intensifying fluoroscopy.
- The x-ray generator must be capable of switching on and off very rapidly. The time required for the x-ray tube to be switched on and reach selected levels of kVp and mA is called the **interrogation time**

Digital subtraction angiography

- Digital subtraction angiography (DSA) is a radiological technique that creates clear images of blood vessels by using a computer to digitally subtract an image taken before a contrast dye was injected from subsequent images taken after the dye was administered. This process removes distracting structures like bones, making it easier to see blood vessels to diagnose conditions such as aneurysms, blockages, or malformations
- Figure 26-15A shows a preinjection mask lateral view of the base of the skull, an image following contrast injection (see Figure 26-15B), and a DSA image obtained by subtracting the mask from the injection image (see Figure 26-15C). The principal result of DSA is improved image contrast.
- Digital subtraction of the static object (the skull) allows better analysis of the opacified arteries, especially in their distal parts. The subtracted images appear in real time and are then stored in memory.

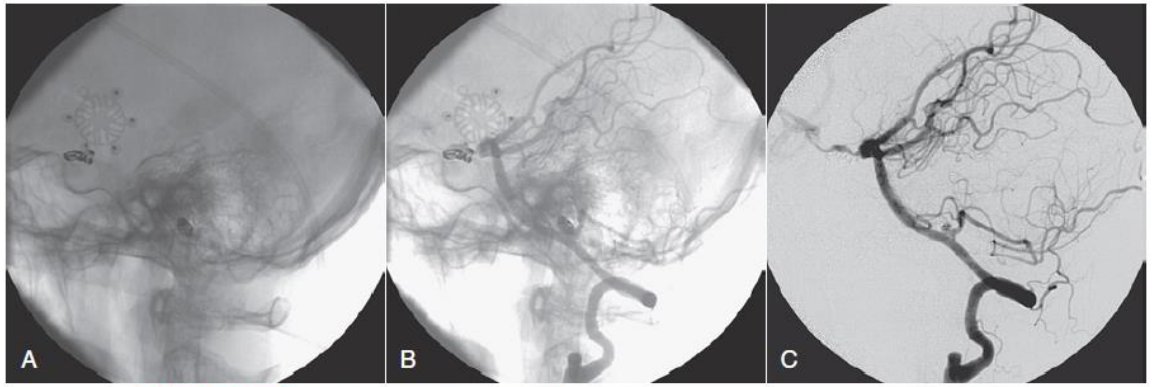

FIGURE 26-15 **A,** The preinjection mask. **B,** A postinjection image. **C,** Image produced when the preinjection mask is subtracted from the postinjection image. (Courtesy Charles Trihn, Baylor College of Medicine.)

References

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- Hendee W., and Ritenour E.,. (2002). *Medical Imaging Physics*. Willy-Liss,Inc