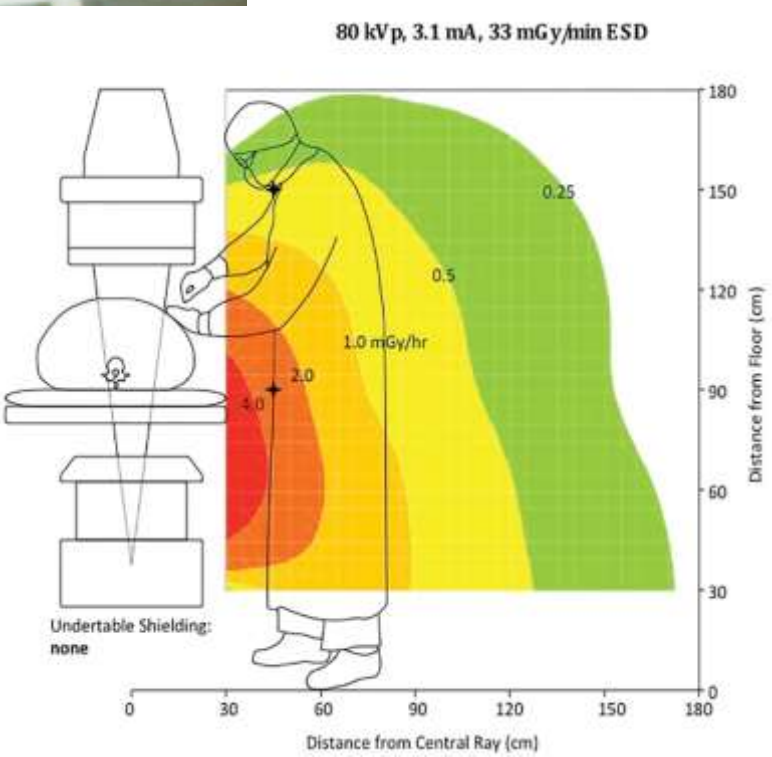


# Fluoroscopy Doses

Fifth Lecture (5)

First semester / Second year

By

Assist. Lec. ASAL AHMED

# Fluoroscopy Doses

## The Magnitude of Patient Doses associated with Fluoroscopy:

Patient doses during fluoroscopically guided anesthetic procedures such as epidural injections have been reported to range between **0.08 and 0.15 mSv per minute** of fluoroscopy when pulsed fluoroscopy of 3- 15 pulses per second is used.

Fluoroscopic procedures involve high patient radiation doses. The radiation doses depend on:

- The type of examination
- The patient's size
- The equipment and the technique used in this equipment
- Entrance skin exposure (ESE) is the best indicator of the fluoroscopy radiation dose; it should be assessed at regular intervals.
- Management of patient exposure involves not only measurement of these rates but also clinical monitoring of patient doses.

## NOW, is there a relationship between Patient and Staff doses in Fluoroscopy?

**Yes. Reducing patient doses will lower staff doses too. The absorbed radiation dose to staff is directly proportional to the dose the patient receives; not attempting to minimize the patient's dose is equivalent to neglecting your own radiation protection.** At one meter, a person will absorb about 0.1% of the patient dose due to scatter and a smaller additional contribution due to leakage through the side of the tube housing.

However the staff dose can be reduced by the use of personal protective devices such as lead aprons, which will not reduce the patient dose. The most common 0.5 mm lead equivalent aprons used by the staff during fluoroscopy attenuate 95% of the scattered radiation to the shielded torso, vs. 80% for the lightweight 0.25 mm aprons. After a lead apron, leaded thyroid shields and eyeglasses provide additional protection in descending order.

## The Effect of the Patient's Physique on the Patient and Staff:

All fluoroscopy systems that operate with automatic exposure control require that a certain amount of radiation reach the detector in order to produce clinically useful images. Most units are equipped with automatic exposure (or brightness) control (ABC) systems.

When a thicker patient is positioned in the path of the X-Ray beam, the AEC system increases the exposure factors (kV, mA) in order to compensate for the increased attenuation in the patient's body, and conversely, the exposure factors decrease when a slim patient or thinner body part is in the beam. This could result in a higher radiation dose and an elevated risk of radiation injury to the skin of thicker patients. The dose to the staff would also increase as a result of an increase in exposure factors.

## The Effect of Equipment and Technique on the Patient and Staff:

Radiation scatter is the primary mechanism of operator and staff exposure, and understanding the factors that can affect its magnitude and distribution is essential.

Figure 1 shows the scattered radiation during anterior-posterior fluoroscopy, with the patient in ventral decubitus.

## Question: What is the best position of the X-Ray sources?

**A:** When the X-Ray source is positioned above the patient, the radiation spreads upward in the room.

**B:** When the X-Ray source is positioned below the table, it directs the distribution of the radiation to the floor.

The best practice in terms of exposure is that by positioning the X-Ray tube below the patient, you decrease the amount of scatter radiation that reaches your upper body.

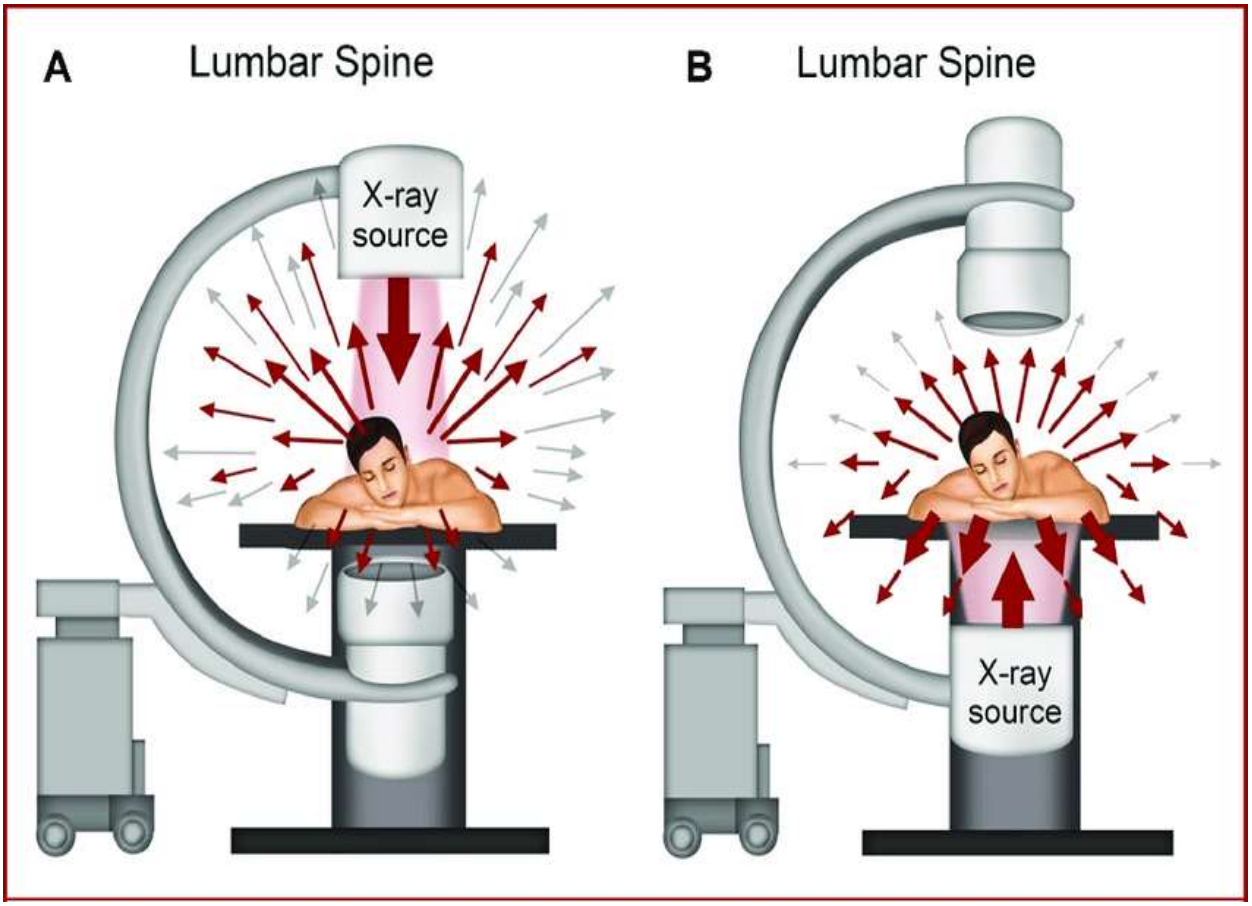


***Figure (1): The scattered radiation during anterior-posterior fluoroscopy.***

Radiation scatter and exposure at a distance depend on the angle of the gantry and the distance of the X-Ray tube to the patient (Figure 2). The tube position relative to the patient and the table height, will determine the amount of radiation scatter.

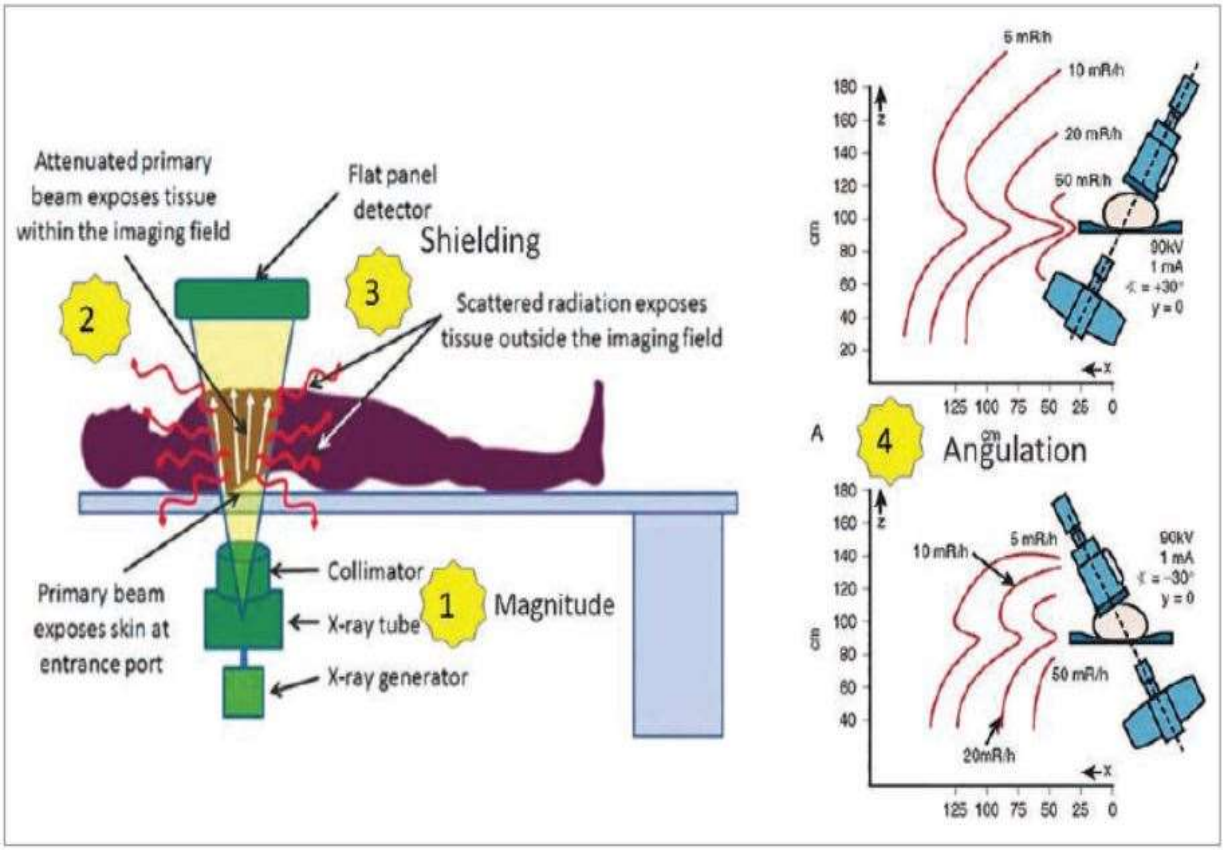


***Figure (2): Shows the effect of equipment and technique on the patient and staff.***

## Radiation Dose Monitoring:

It has been demonstrated experimentally that the dose to nursing staff and technologists of X-Ray during fluoroscopic procedures can be **Similar to Higher** than that received by the physician, with evidence of an increasing trend toward higher dose levels for technologists working in this environment. It is therefore important to quantify the radiation exposure of individuals working within fluoroscopic departments. Direct monitoring of patient doses during procedures is highly desirable, but current methods still have serious limitations. Skin doses may be reduced by using:

- Intermittent exposures
- Grid removal
- Last image hold
- Dose spreading
- Beam filtration
- Pulsed fluoroscopy and other dose-reduction techniques
- Proper training of fluoroscopic operators, understanding the factors that influence radiation dose, and the use of various dose reduction techniques may allow effective dose management.

## Question: How effective is the reduction in exposure time for patients and staff?

Very effective. Fluoroscopy time is the easiest parameter to control. Minimizing fluoroscopy time has been proven to be one of the most effective ways of reducing radiation doses to the patient and staff during fluoroscopy.

Experience has shown that a substantial reduction in patient dose may be achieved by limiting the fluoroscopy time. However, it is important to note that fluoroscopy time is not the only parameter that reduces the dose to the patient.

## *What about Pregnancy?* Should termination of pregnancy be considered after a Fluoroscopically guided procedure?

Not invariably, unless the primary beam passes through the fetus. If the X-ray beam is directed at body parts other than the pelvic and lower abdomen regions, it is unlikely that the dose received by the fetus would approach a level at which a termination would be considered. If the primary beam irradiates the chest or upper abdomen region, only scattered radiation from within the patient's body, mostly internal scatter, will reach the fetus. However, the exposure of pregnant women to radiation is always a concern when the primary beam approaches the fetal area.

In such situations, where the fetus is in or near the primary beam, the procedure should only be performed if it is essential for managing the patient's condition. When such interventions are clinically justified on an individual basis, every optimization effort should be made to achieve the desired clinical result with the least possible exposure to the fetus.

## Methods of Minimizing the Fluoroscopy Doses:

Figure 3 shows an example of optimal table positioning to minimize patient doses.

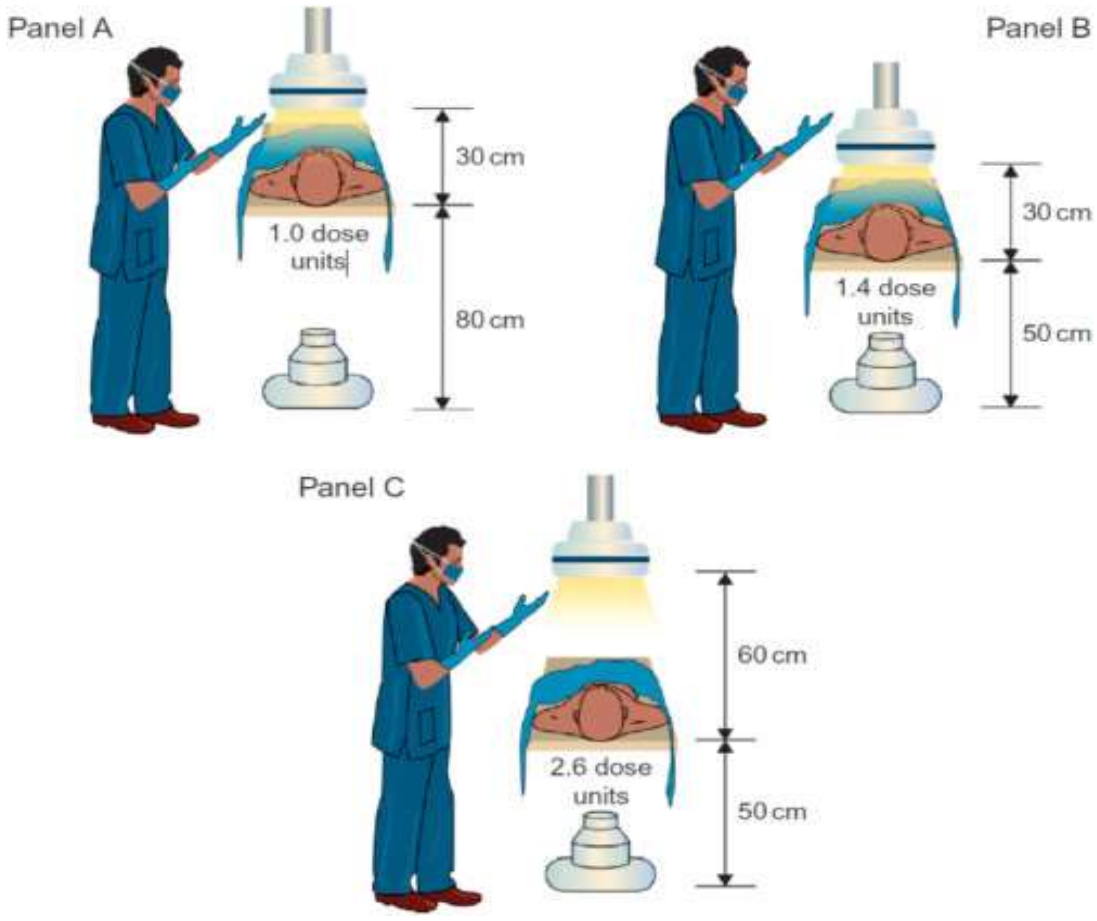


***Figure (3): An example of optimal table positioning to minimize patient doses.***

**Panel A-** The patient is placed away from the radiation source and close to the image intensifier.

**Panel B-** A lower table setting without changing the source-intensifier distance results in a higher dose due to the proximity of the patient to the radiation source.

**Panel C-** Elevation of the image intensifier results in a higher dose owing to the geometric magnification of the intensifier.

## *Question*: Which one is the best position?

The personal behavior within the fluoroscopic suite alters the dose considerably. Depending on their responsibilities during the procedure, the technologist may have a greater opportunity to deliberately increase their distance from the patient, resulting in a decrease in dose.

Some key words for the most important methods of minimizing fluoroscopy doses for patients:

- Know your equipment and how to use it
- Maximize the distance of the X-Ray tube from the patient to the extent possible
- Minimize the distance of the detector from the patient
- Minimize the fluoroscopy time
- Be aware that oblique projections and lateral views will result in a higher patient dose
- Vary the position where the beam enters the patient; avoid irradiating the same part of the skin by using rotation
- Keep a record of the patient dose (Kerma area product (KAP) and skin dose)
- Avoid using a large field of view or magnification
- Be aware that skin injuries can happen; advise the patient to keep a watch on their skin and inform you in case of a skin reaction.