

## Radiation safety: Minimizing your dose

Any interventional radiologist or radiation worker should be conscientious of radiation exposure; however, this is key for the pregnant interventionalist. Reduction of dose during image-guided procedures follows the “as low as reasonably achievable” (ALARA) principle. It is important to remember that reduction of dose to the patient will also reduce the dose to the everyone in the angiography suite. Scatter radiation from the patient provides the highest level of radiation exposure to the operator.

### A. Principles for minimizing dose: time, distance and shielding

#### 1. Time

- Dose is directly proportional to time. The amount of time the fluoroscopy beam or CT scanner is on will directly affect dose.
- Techniques to modulate the time you are exposed to radiation
  - » CT
    - › Consider using intermittent CT rather than CT fluoroscopy and stepping out of the room between scans.
    - › Consider using ultrasound guidance when safe and possible.
    - › If available, consider using ultrasound fusion technology to decrease scan time and reliance on ionizing radiation.
  - » Fluoroscopy
    - › Utilize “fluoro stores” rather than repeating each run with digital subtraction angiography (DSA).
    - › When performing DSA, consider performing a power injection run and leave the room during imaging.
    - › Optimize the fluoroscopy unit in line with ALARA.
    - › Utilize last image store instead of repeating with single shot.

#### 2. Distance

- Inverse square law: dose is inversely proportional to the square of the distance from the source. By doubling the distance from the source, you will quarter your dose.
  - » Always take a step back away from the patient when possible.
    - › One meter from the patient with vertical image intensifier: the operator will receive approximately 1/1000 of the patient’s skin entrance dose. By moving 2 meters from the patient this will be one-fourth of the dose.
  - » Leave the room if doing DSA.
    - › When possible, perform injector DSA so you are able to leave the room rather than hand inject for DSA.
  - » If doing a “hand run” or hand-injected DSA, move as far from the patient as your catheters will allow you.
    - › If you are working with trainees or technologists and are not the one physically performing the injection, leave the room or stand behind other operators.

- » Patient positioning: The patient should be positioned as far from the source and as close to the receptor as possible. This will reduce scatter to the patient which directly reduces the dose to the operator. When performing a lateral projection, the scatter will be higher on the side of the source and lower on the side of the receptor.
  - › Position the patient in a way that is still ergonomically feasible to comfortably work while decreasing the dose.
    - Some interventionalists may choose to use a stool in order to get the patient closer to the receptor and decrease scatter.
  - › Try to position yourself on the side of the receptor, not the source, when performing a lateral view.
  - › Never straddle the source during lateral projection imaging.

### 3. Shielding

- Proper use of shielding can greatly reduce your dose.
- It has been recommended that a pregnant interventionalist wear a minimum of 0.5-mm lead equivalent over the abdomen.
  - » Some choose to wear a second layer of lead; however, this offers very little additional protection and, due to added weight, can increase back pain and risk of back injury.
  - » Utilize all additional shielding available.
    - › Lead table drapes should be between the operator and the x-ray source but out of the field of view of imaging (this will increase the dose).
    - › Overhead lead shields should be positioned close to the patient between the II receptor and the operator.
    - › Ask for the shield to be prepped in, even if it is a short procedure.
    - › Additional shielding may be available to decrease scatter such as RadPads or reusable lead shields that can be placed around the access sites.
    - › If you are not the primary operator, stand behind them as other scrubbed colleagues can act as “human shields.”

## B. Optimize the equipment settings to minimize dose following ALARA principles.

1. Some fluoroscopy units have high-, standard- and low-dose modes. Use the lowest possible dose mode while still ensuring a clinically sufficient exam.
2. Decreasing frame rates directly decreases the radiation dose. Use the lowest frame rate that provides an acceptable image.
  - For example, decreasing the frame rate from 30 frames per second to 7.5 frames per second will decrease the dose by three quarters.
3. Remember that magnification views increase dose but collimation decreases the dose.
  - Collimate as much as possible.
  - Use soft cone as well as hard collimation.
  - Only magnify if needed.

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