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Consultant Medical Radiation Health Physicists

Presents:

***Fluoroscopic Technology Competency
and Associated Radiation Protection***

Fluoroscopic Procedures Applicable

1. P.I.C. Lines
2. Dysphagia/Speech Therapy

PA BRH Required Training

1. You must be trained by a physician, another qualified technologist, application specialists, or medical radiation physicist.
2. You must know every dial, switch, button, etc. on your equipment that you operate.
Some examples are.....

Examples of Fluoroscopy Unit Operator Control Parameters

- kVp
- mA
- Auto-kVp; Auto-mA; Auto-both
- Image Intensifier Image Size (Mag Modes)
- Last Image Hold Feature
- Digital, Pulsed, Continuous, Spot Modes
- Frames/sec; Pulse Width; Digital Cine

Technique Charts

Technique Charts must be either provided by the manufacturer, or developed in the early stages of utilization. These charts define protocol settings for fluoroscopic studies and spot filming.

Collimation

The collimator jaws must be seen on all size modes of the image intensifier (II). All constant and spot film images must be “coned-down” to the minimum field size required. For example, if a newborn is having a barium swallow, no body parts except the upper chest should be visible on the image screen. Obviously, immobilizing devices must be used to achieve this.

Filters and Spacer Cones

Rarely does the technologist adjust filtration today during fluoroscopy, but spacer cones are used in C-arm Fluoroscopy. If the spacer cone must be removed for a specific or difficult case, make sure it is replaced following the completion of the case. The spacer cone requires the X-ray tube to be kept a safe distance from the patient. Removal of the cone could cause radiation doses to exceed skin erythema thresholds (cause skin reddening).

Patient Gonadal Shielding

The policy for gonadal shielding is to optimize its use. This means that you must use as much as possible without covering the field of interest. Gonadal shielding is only required when the region of interest is in the pelvic area. For instance, it is inappropriate to use a gonad shield on a patient having an erect chest or higher X-ray procedure. A general “rule-of-thumb” is that if the light field does not project onto the gonadal area, then no shielding is necessary. The use of gonadal shielding in this instance, only confuses patients. Some may argue with you that they got lead shields elsewhere or in dental offices, so they demand them. In this case, provide them-with a “the customer is always right” attitude. It cannot hurt them (unless it is too heavy), but it won’t help them either-as help is not required.

Image Intensifier/Tube Height

The X-ray tube should be kept as far from the patient as possible. The image intensifier may be adjusted to as close to the patient as reasonably possible. This will minimize the patient dose from primary X-rays. The staff exposure from scattered X-rays are best minimized by standing back from the table as far as possible to carry out job duties. Keep the table as low as possible. Remember shorter people will get more eye scatter than taller people.

Lead Shielding in Fluoroscopy

Lead tableside shields, lead drapes from the II tower, lead acrylic satellite shields, mobile lead shields, leaded glasses with wraparound side shields, lead aprons, and leaded thyroid shields are all used to reduce staff exposure in fluoroscopy. The use of lead wraparound aprons can cause spinal compression injury-use only those that have proper weight balance straps. The use of skirt/vest type lead amalgams with tin minimizes the weight problem. Lead thyroid shields are rarely needed, and are not required. Proper use of lead acrylic pull down or interposable shields should precludes the necessity for these type shields. The thyroid is not especially sensitive to external X-irradiation, even if you've had personal medical radiation exposure to your thyroid.

Use of the Grid

Insertion or removal of the grid is an important parameter that should be in all technique protocols. To inadvertently leave it in when unneeded would cause at least twice the dose necessary. To remove it, when needed, would result in a poorer image that may require the fluoroscopist to take excessive imaging time.

Where to Wear Your Badge?

You may have a film badge, T.L.D. badge, or a photostimulable-phosphor badge (Luxel), but all badges in fluoroscopy are to be worn outside the lead apron. Take care to remove your badge from your lead apron following the procedure, as someone else may wear that apron. If you are pregnant, you will be assigned a second badge (the baby badge), to be worn under the lead apron when you notify your supervisor in writing that you are pregnant. If your badge outside the apron approaches the regulatory limits (discussed later), an Effective Dose Equivalent formula can be applied to your readings to better represent your overall risk. This usually results in a reduction to 30% of your badge reading. So there is no reason for any fluoroscopist not to wear their badges.

Radiation Exposure Units

Exposure Unit: Roentgen (R) or Coulomb/kilogram (C/kg)

Absorbed Dose Unit: RAD or Gray (Gy)

Dose Equivalence Unit: REM or Sievert (Sv)

Centi = 1/100 10 cGy = 1 RAD 10 cSv = 1 REM

Milli = 1/1000

Micro = 1/1,000,000

1 R = 1 RAD = 1 REM for X-rays used in fluoroscopy

Regulatory Exposure Limits

Patient Limits: < 5R/min if only manual fluoroscopy

<10 R/min conventional fluoroscopy

<20 R/min high dose rate mode fluoroscopy

Cine not specifically limited

Staff Limits: <5 REM or 5000 mREM/yr.

<500 mREM/9 mo. ,if declared pregnant in writing

**<50,000 mREM or 50 REM extremities including
skin and thyroid**

<15,000 mREM or 15 REM eyes

General Public: <500 mREM/yr., excluding medical procedures

Film/Screen/Processing

The technique's protocol should include the manufacturer's film type, screen type and speed, and processing parameters for spot filming. This includes film and screen compatibility/matching. For laser imagers, the SMPTE test pattern Q.C. test should be performed on a regular basis. All radiography and fluoroscopy operations are required by the PA BRH to have a Quality Assurance Program. You should know what yours is, and where the details can be found.

Processor Q.C.

Use only the processor and chemicals that the film manufacturer recommends. Use the processor temperature that the film manufacturer requires. Know what O.D. range is specified or that can be expected-obtain this from the film manufacturer or clinician. Know who assures your processor's quality control, and where their quality control chart is. This is now required by PA BRH. As part of your facility's Quality Assurance Program.

Quality Assurance Program

Know where you can find the details of your required Quality Assurance Program, and who is responsible for it. It needs to include processor Q.C., X-ray machine performance evaluations, preventive maintenance plans, and where radiation safety surveys are filed (some originals may have been years ago).

Film Artifacts

The film manufacturer should be able to alert you to what film artifacts to expect from the film, chemistry, processor combination that you are using. Textbooks are also available on the subject from major manufacturers. A knowledge of what the artifacts look like, then what causes them, then how to detect and prevent them must be learned. A regular commitment to processor roller cleaning can go a long way to reduce processor artifacts.

Film Optimization

- 1. Have a quality control chart with established control and operating levels**
- 2. Get feedback from clinicians about acceptable O.D. ranges**
- 3. Test O.D. ranges by sensitometry, as is done in mammography**
- 4. If using a laser imager, use SMPTE test pattern daily to weekly**

Anatomy and Physiology

Have a working and communicating knowledge of medical terminology that includes anatomy and physiology as it applied to radiology.

Positioning and Preparations

Have a working knowledge and be able to communicate the instructions to patients to get them in the proper positions for the fluoroscopic procedures desired.

Have a knowledge of each preparatory procedure that each patient must have for each fluoroscopic procedure to be performed. Some of these will have been the patient's responsibility, and some will be yours. Ultimately, both are required to be completed prior to commencement of the procedure.

Emergency Procedures

Emergency procedures must be known for each scenario that can be reasonably expected. This may include medications, first aid, removing the patient, terminating the exposure manually, or vacating the room.

Continuing Education

Education must be provided commensurate with the duties of the individual. This must include how to operate the equipment safely and effectively. This must also include an annual radiation safety in-service. This education can be live, videotaped, web-based, or PC interactive. A minimal orientation education must be performed before any individual, who is asked to perform a procedure utilizing X-irradiation, begins their duties.

Awareness of Radiobiological Risk

If one area of the skin is irradiated with constant fluoroscopy for over 40 minutes at conventional fluoroscopy exposure, it is possible that skin reddening (erythema) can result within days, and last for a few weeks. If the area includes hair, mild epilation can occur following exposures greater than 80 minutes of conventional fluoroscopy. Keep in mind this is one portal, or skin area only. Also keep in mind that this does not include the addition of digital or other cine dose that the patient may get to that same skin area. Also, it does not include the fact that the patient may have had previous fluoroscopic exposures to that same skin area. High dose rate fluoroscopy provides doses in half the time. The FDA has provided a warning about all this.

Pregnancy Risks

When a female patient is within child-bearing age (8-60) and they must have a fluoroscopic or radiographic exposure to the pelvic area, certain notifications are required.

- 1. Contact a radiologist before performing the study.**
- 2. In some cases the patient will be required to have a negative pregnancy test result prior to performing the radiologic or fluoroscopic test.**
- 3. Ask the patient if there is any reason that it would be impossible for them to be pregnant, i.e. they had a hysterectomy, etc.**
- 4. Remember, exposures to areas not in the pelvis are not counter-indicated just because the patient is pregnant. Collimation is the patient's best safety measure-in this case-not a lead apron draped over them.**

Conclusion

Performance of X-ray imaging by radiography or fluoroscopy by technologists should always have a physician present. If the technologist has been trained to operate the fluoroscopic X-ray equipment without the physical presence of a physician, it is assumed that the technologist is being supervised by a physician indirectly. It is also assumed that no technologist will make or provide diagnoses directly to or for patients.

For additional instruction in safe handling of fluoroscopic X-rays, access my website:

www.walterrobinson.com for the presentation entitled: “Fluoroscopic Radiation Management”