Q.A. Collectible

Sponsored by CRCPD's Committee on Quality Assurance in Diagnostic X-Ray (H-7)

Computed Tomography Fluoroscopy

Computed tomography (CT) fluoroscopy is one of many recent advances in medical diagnostic imaging. With the advent of computers capable of processing large amounts of information almost instantaneously, and the development of slip-ring technology, CT fluoroscopy has become a useful tool for physicians performing interventional procedures. The anomaly in the patient is located with conventional CT imaging, then the physician uses CT fluoroscopy to track the position of a biopsy needle. Simple biopsies require only a few seconds of CT fluoroscopy on-time, but during more complicated procedures, the patient may be exposed to five minutes or more of radiation exposure.

What are the health and safety issues?

- Scatter radiation with air kerma rates as high as 51.7 µGy/sec (5.9 mR/sec) was observed 10 cm from the scanning plane on one surveyed system.[1] Therefore, the physician's hands are subject to a potentially high cumulative occupational exposure.
- The technique factors used are normally similar to what is used for a typical axial or helical procedure, except that the couch normally does not move. (There are instances when the couch is moved 1 or 2 centimeters by the physician to improve the image of the area being biopsied.) Numerous scans of the same anatomical slice are created so that the physician may track the location of the needle during the biopsy. If the typical skin dose is taken to be 3 cGy for an abdomen scan obtained in one second, one minute of CT fluoroscopy at that level yields 60 x 3 or 180 cGy/min (180 R/min). Compare this to regular fluoroscopy where the maximum tabletop (skin) dose rate is only 10 cGy/min (10 R/min). The CT fluoroscopy rate is ALMOST TWENTY TIMES the maximum fluoroscopy exposure rate and 60 to 90 times more than a typical fluoroscopy exposure rate of 2 to 3 cGy/min (2 to 3 R/min). Add this to the exposure the patient receives during as many as five typical scans delivered during the preparation phase of the procedure, and it is easy to see how they may receive enough radiation exposure to cause erythema.

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Important objectives of a radiation safety inspection:

- Inspectors should make certain facilities capable of CT fluoroscopy are aware of the potentially high radiation exposure.
- Facilities should be encouraged to use lower exposure techniques for interventional procedures. Nawfel et al determined that a patient skin dose of 100 cGy (100 R) would be reached after 96 seconds of exposure at 120 kVp and 90 mA on their particular CT system. By adopting a lower exposure technique of 80 kVp and 135 mA whenever possible, the facility lowered patient dose by more than 50%.
- Protocols should be evaluated with regard to ALARA. Positioning a lead apron over the patient, adjacent to the scanning plane, will substantially reduce scatter radiation exposure to the hands of occupationally exposed individuals. It is also advisable for the physician to employ the use of needle holders to increase the distance between his hand and the primary beam.[2] By adopting these ALARA techniques, the physician will be able to conduct more procedures without exceeding their maximum permissible dose.
- Inspectors should confirm that there is a monitor readily viewable by the physician standing near the patient.
- The physician should control the exposure with a dead-man type switch.
- The fluoroscopy irradiation time should be readily available to the physician.
- Specialized training that addresses radiation risk and CT operation should be available for the physicians.
- Adequate dosimetry for the physician (whole body and extremity).

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[1] Nawfel RD, Judy PF, Siverman SG, Hooton S, Tuncali K, Adams DF. Patient and personnel exposure during CT fluoroscopy – guided interventional procedures. Radiology 2000; 216: 180-184

[2] Kato R, Katada K, Anno H, Suzuki S, Ida Y, Koga S. Radiation dosimetry at CT fluoroscopy; physician hand dose and development of needle holders. Radiology 1996; 219:576 –578.

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