Heavy Metal Pad Shielding during Fluoroscopic Interventions

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Significant direct and scatter radiation doses to patient and physician may result from routine interventional radiology practice. A lead-free disposable tungsten antimony shielding pad was tested in phantom patients during simulated diagnostic angiography procedures. Although the exact risk of low doses of ionizing radiation is unknown, dramatic dose reductions can be seen with routine use of this simple, sterile pad made from lightweight tungsten antimony material.

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THE increasing use of imaging to guide procedures has been accompanied by public health concerns about radiation exposure to patients and health care personnel (1). Whenever a medical image is obtained, a compromise must be made between the quality of the image and the radiation dose used to make that image. Certainly, the lowest dose that can produce a diagnostic image is ideal, which leads to the ALARA principle ("As Low As Reasonably Achievable") (2). This concept is paramount with the use of fluoroscopy because of continuous x-ray production and real-time imaging.

Interventional radiology procedures may expose the patient and physician to the effects of direct and scatter radiation (3). Patient exposure is usually mostly direct radiation, whereas physician exposure may be mostly scatter radiation (4). Biologic effects of ionizing radiation can be categorized as acute or delayed. Although the acute effects of radiation are not commonly a problem, the delayed effects remain a poorly quantifiable concern. Because the delayed effects may take years or decades to appear, they are difficult to distinguish from effects caused by other sources. For this reason, they are considered stochastic rather than deterministic effects. The likelihood of a stochastic effect is directly related to the radiation dose, but its severity is not related to the total dose received. Examples of stochastic effects include carcinogenesis and genetic mutation. This type of effect is of particular concern because it may occur at any dose and there is no threshold dose at which it occurs. However, the lower the dose received, the lower the incidence of consequences that will develop. The principle of ALARA is based on this concept.

The deterministic effects do have a threshold dose, and beyond this threshold, the severity is directly related to the dose (ie, cataracts, skin burns) (5,6).

In fluoroscopy, the exposure to ionizing radiation can be diminished in several ways, including judicious use of fluoroscopy, use of intermittent or pulsed fluoroscopy, holding of the last image, reduction of field size (ie, collimation), and minimization of field overlap (3). The use of intermittent fluoroscopy can diminish the radiation by 20%–70% (7). Additional methods described include minimization of the distance between the patient and the intensifier, maximization of the distance between the patient and the operator, choice of appropriate parameters to operate the machine, and use of movable lead surface shields (8,9) and shielded gloves (10,11).

The purpose of our study was to evaluate radiation exposure with and without a novel shielding device during interventional radiology procedures in the angiography suite for the patient and operator.

MATERIALS AND METHODS

A human adult anthropomorphic phantom (The Phantom Laboratory, Salem, NY) consisting of a torso and head was used that was constructed from a proprietary urethane formulation with an effective mass density that closely simulated muscle tissue with randomly distributed fat. This urethane encased a chest, abdomen, pelvis, and cranial skeleton. The phantom was composed of 35 axial slices, each 2.5 cm thick, that extended from the head to the proximal aspect of the thigh. Some of the slices were taped together, leaving two separate spaces at the neck and pelvis in which dosim-

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