Using a Sterile Disposable Protective Surgical Drape for Reduction of Radiation Exposure to Interventionalists

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OBJECTIVE. The purpose of this paper is to show the effectiveness of a new radiation protection method designed to decrease the amount of scatter radiation received by practitioners performing procedures under fluoroscopic guidance.

MATERIALS AND METHODS. A sterile, disposable, lead-free surgical drape containing radiation protection material composed primarily of bismuth was evaluated for effectiveness in reducing radiation doses to health care personnel. Measurements of phantom scatter, patient scatter, skin entrance, and the effects of collimation, together with comparative monthly thermoluminescent dosimeter recordings, were taken to determine the effectiveness of X-ray beam attenuation using the bismuth drapes.

RESULTS. Scatter radiation to physicians, as measured by thermoluminescent dosimeters placed on each eye, the thyroid, and the wrist, was reduced by 12-fold for the eyes, 25-fold for the thyroid, and 29-fold for the hands when the radiation-attenuating surgical drape was used when compared with control studies performed with a standard nonattenuating surgical drape alone. Monthly thermoluminescent dosimeter measurements decreased fourfold in one physician. Using the protective drape reduced exposure to the assistant in each case to negligible levels. Skin entrance dose was not increased unless the protective drape was placed directly in the X-ray beam. An X-ray attenuation factor equivalent to 0.1 mm of lead with 8×8 cm collimation reduced the scatter rates from five- to ninefold despite a 30–40% increase in entrance exposure rate as the lead equivalence increased.

CONCLUSION. Depending on the procedure, the height of the practitioner, and the positioning of the radiation-attenuating surgical drape, use of this drape can substantially reduce the radiation dose to personnel with minimal or no additional radiation exposure to the patient.

The harmful effects of ionizing radiation were recognized shortly after the discovery of the X ray by Wilhelm Conrad Roentgen in 1895 [1–5]. These harmful effects were particularly evident in the hands of individuals exposed repeatedly to the X-ray beam for prolonged periods of time. Erythema, dermatitis, and skin cancer were found to result from this exposure, and it was initially thought that avoiding the primary beam was sufficient protection [2, 6–9]. However, in the 1920s concerns regarding the adverse effects of radiation were again raised with the identification of an increased rate of leukemia in radiologists [1]. This recognition led to the creation of organizations such as the International Commission on Radiological Protection (1928) and the National Committee on Radiation Protection and Measurements (1929, later the National "Council"), which became important in making recommendations on radiation protection. The first recommendations for tolerance doses for radiation workers came from the National Council on Radiation Protection and the International Commission on Radiological Protection in 1934. The recommendations of both those organizations for tolerance doses for radiation workers have decreased by a factor of 5–10 since 1934. This decrease is the result of increased knowledge of the risks from radiation exposure, an increased desire among workers to avoid the harmful side effects of radiation, and improvements in technology [1, 3–5, 8–13].

Although the recommended limit for radiation workers has not changed greatly since about 1958, the philosophy toward radiation protection and limits has changed dramatically. The limit is now regarded as an upper limit of acceptability. The principle of ALARA (as low as reasonably achievable) is

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