Evaluation of Scatter Absorbing Patient Drape

Talon Thompson & Danielle Hohreiter
Southern California Permanente Medical Group, Los Angeles, CA

KAISER PERMANENTE®
SOUTHERN CALIFORNIA PERMANENTE MEDICAL GROUP

Introduction

In operating rooms that utilize ionizing radiation the scattered radiation from the patient is cause for concern for the staff in the room during the procedure, whether it be the operator, nurses, technologists, ect.
There are a multitude of ways in reducing the scatter to the operator and staff in the procedure room, but one such way is adding a layer of attenuating material between the patient and the staff in the room.
The aim of this study was to verify the manufacturer's claim of reducing scatter to personnel without increasing patient dose in any capacity.

Figure 1. Left side depiction of vendor's drape. Right side example leaded sheets used to verify vendor's claims.

Methods

An angiographic fluoroscopic system and C-arm were utilized for data collection of ionizing radiation. Measurements were taken with and without the vendor's 0.25mm-Pb equivalent drape. 3 different lead aprons (thicknesses of 0.25 mm, 0.35 mm, and 0.5 mm) were compared as attenuators for verification of the vendor's drape. The ancillary equipment used included body phantoms, a survey meter, and a digital multi-sensor detector.
In the angiographic room the scatter setup to the operator without any attenuation 50 cm away. The technique of the unit was changed to verify that different levels of radiation were measured. Then with the radiation drape on the side of the phantom the survey meter recorded the scatter. The other apron thicknesses were rotated in where the operator would stand to measure scatter radiation.
Measurements taken with the mobile C-arm were collected in a similar manner as described above.

Figure 2. Displays the physical setup of measuring the operator scatter at the side of the operating table.

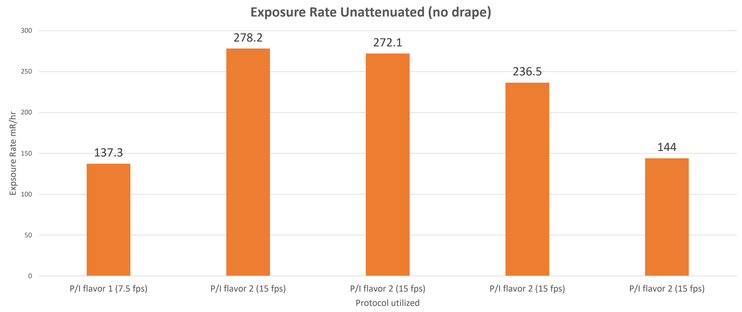

Figure 3. Displays the exposure rate without any attenuating material between the survey meter and the phantom implementing the pelvis/iliac (P/I) flavor at 19" (7.5 fps), 19" (15 fps), 14.4", 10.5", and 6" magnification, respectively. The technique for each magnification change caused the scatter to decrease and the entrance exposure to steadily increase. Without the addition of any attenuator, it is seen that technique changes can initially reduce scatter.

Results

To set a baseline for all values collected, unattenuated values were measured and recorded changing the technique for the units. Both units produced the same trend of data, so the angiographic unit's data is represented in the graphs here. The drape and various lead apron thicknesses were introduced, and scatter values were recorded where the operator would stand. Measuring the exposure values for the different magnifications is seen in Figure 3. Just switching between the 1st two protocols in changing the fame rates the exposure rate drastically changed. The baseline scatter for open collimation and no magnification, without any attenuation, was recorded as 278 mR/hr seen in Figure 4. Using only a 0.35 mm-Pb apron 18.5 mR/hr was recorded. Utilizing only the drape on the side of the phantom 50.3 mR/hr was recorded. With the drape and a 0.35 mm-Pb apron 3 mR/hr was recorded. Figure 5 shows how collimation can change the exposure rate for the different attenuating materials. Figure 6 depicts how introducing the drape into the radiation field can affect the scatter by driving up the technique factors of the unit.

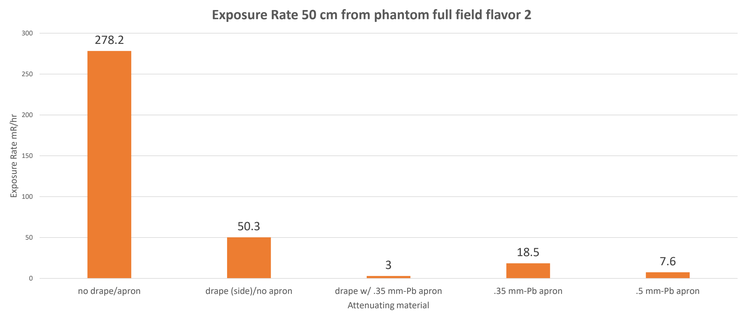

Figure 4. Displays the exposure recorded by different materials in the scatter path with a wide-open collimator. With more material in the scatter path the survey meter reads a lower value. With the drape on the side as shown on the right above the meter read over 6 times lower. With only the use of a 0.35 mm-Pb apron the meter recorded around 15 times less exposure.

Backscatter measurements from the drape towards the phantom were minuscule. When the 0.25 mm-Pb drape was measured against the 0.25 mm-Pb apron the results indicated that the vendor's drape was not equivalent. The exposure value from the drape read 65.2 mR/hr and with the known 0.25 mm-Pb equivalent sheet the reading was 38.9 mR/hr.

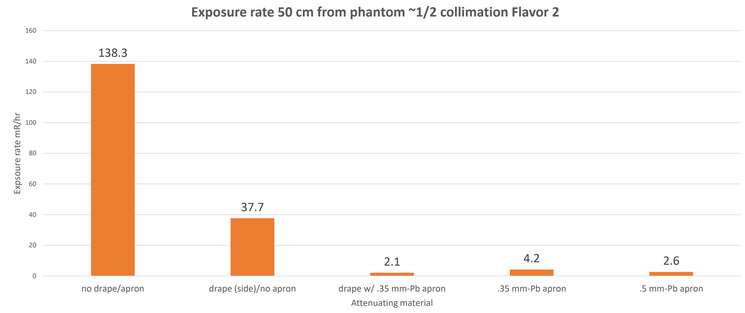

Figure 5. To observe if the collimation changed the trend of scatter, the collimation was reduced to roughly half field the exposure rates for the various attenuating setups were recorded on Figure 3. Between the various attenuating materials, the entrance exposure rate and the technique stayed constant.

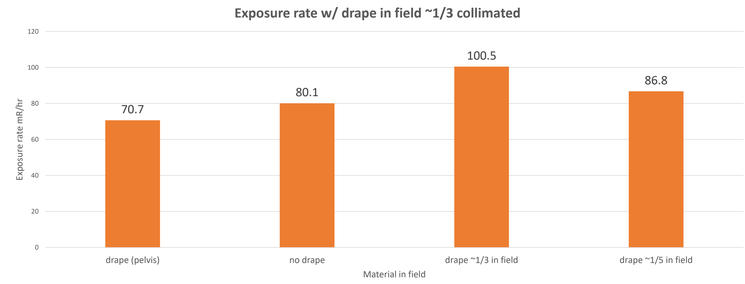

Figure 6. The drape was introduced into the irradiated field to confirm the assumption that the added attenuation would drive up the technique of the unit. The amount of material needed in the field to raise the technique 4 kV and 0.7 mA was about 1/3 of the irradiated field covered. This effect was visually very noticeable in the resultant image. By introducing the drape into the field, it drove the entrance exposure and the scatter readings up.

Discussion

With the drape on the side of the phantom the exposure rate was cut 73%. With a 0.35 mm-Pb apron the exposure rate was cut 97%. With the drape and 0.35 mm-Pb apron the exposure rate was cut 98.5%. Along with the cost and waste generated by this single use product the efficacy is questionable. An advantage would be reducing the overall scatter that has the most impact on areas of the body not already protected by a regular lead apron or lead glasses. Disadvantages include would be the potential of an increase in patient technique and dose by improper use increasing exposure to the patient and staff, and the cost & waste generated by the product since it's a single use material. It is also a California requirement that all staff in the procedure room be wearing at least a minimum of 0.25 mm-Pb equivalent apron. Each state may specify something different. Seeing as how the 0.35 mm apron cuts the exposure rate by 97% and adding in the drape marginally increases that by 1.5%, I do not believe purchasing the drape for each exam is cost effective nor adds any real benefit to reducing the risk of radiation exposure to the personnel.

Conclusions

Although the drape slightly reduces operator exposure, the measurements and data collected shows that it doesn't meet lead equivalency claims and the cost benefit is debatable. The amount of exposure that is reduced by the drape and apron versus the apron only marginally decreases the exposure rate to the operator. An operator's knowledge of dose reduction techniques can similarly decrease exposure to the operator.

Contact

Talon Thompson, Danielle Hohreiter
Kaiser Permanente
Southern California Permanente Medical Group
Medical Imaging Technology and Informatics
4580 Electronics Place, Los Angeles, CA 90039
Talon.x.thompson@kp.org,
danielle.l.hohreiter@kp.org