Fluoroscopy Operators’ Brains and Radiation

The recent article by Reeves et al. (1) highlights concerns of many health care providers who work with fluoroscopy. The authors investigated the effect of wearing a radiation-attenuating cap on reducing radiation exposure to the brains of fluoroscopy operators. I was troubled, however, by the significant limitations of the study and the authors’ oversimplification of this important issue.

Accurately measuring radiation is a necessary component of this study, yet the study fails to consider the appropriateness of the radiation detector used. The Laudauer nanoDots used in this study were calibrated to measure primary radiation from an 80-kVp diagnostic x-ray beam with a half value layer (HVL) of 2.9 mm of aluminum, which has significantly different physical properties than the scattered radiation being measured in this study.

More distressing, however, are the omissions made in discussing the biological effects of the radiation measured in this study. Taking into account the average thickness of the human skull (2), the spectrum of the scattered x-ray beam (3), and the x-ray attenuation properties of bone, one can estimate that ~40% of the scattered radiation is absorbed by the skull and never reaches the brain. Additionally, the tissue weighting factor for brain tissue is 0.01. (Compare this with the tissue-weighting factor of 0.12 of breast tissue.)

Finally, the authors leave out any discussion of the biological effects (or lack thereof) of the amounts of radiation measured in their study. The highest radiation exposure was measured on the left side of the heads, outside the cap, an average of 1.02 mrad (or 10.2 µGy) per case above background. Taking into account the attenuation provided by the skull and the tissue-weighting factor of the brain, this equals a tissue dose of ~0.06 µSv. Data suggest that the vasculature in the brain may show damage at doses as low as 150 mSv (or 150,000 µSv). According to the study data, a physician could perform almost 2.5 million cases before the left side of the head is exposed to levels of radiation thought to be of risk.

Others have reported a prevalence of left-sided brain and neck tumors in interventional physicians (4) and acknowledged the limitations of these data. In recounting the data reported by Roguin et al. (4), important information is often left out, namely, the bias of self-selection and a lack of comparison with brain and neck tumors in nonradiation workers. In fact, it has been demonstrated that among the general population, some tumors occur more frequently on the left side of the brain (5). Without these comparisons and context, the self-reported cases discussed in these previous papers are difficult to interpret.

The authors point out that wearing the cap reduces radiation exposure to the head by as much as a factor of 16. Although this sounds like a large dose reduction, 16 times a very small number is still a very small number. The bottom line here is that manufacturers of radiation-attenuating caps are basing their advertising on fear, not science.

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Please note: Dr. Marsh has reported that she has no relationships relevant to the contents of this paper to disclose.

REFERENCES

REPLY: Fluoroscopy Operators’ Brains and Radiation

We appreciate the interest of Dr. Marsh in our publication regarding the cranial exposure to radiation scatter for operators during invasive cardiology procedures (1). The critique seems to be based on a misunderstanding of the study’s design and objectives. The study was designed to measure the differential radiation exposure to various regions of the cranium during invasive cardiovascular procedures.

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