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Reconsidering the Value of Gonadal Shielding During Abdominal/Pelvic Radiography

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Shielding the gonads, especially when imaging children with ionizing radiation, has been widely accepted as good radiologic practice since it was introduced approximately 60 years ago [1,2], when some of the first estimates of radiation dose to the reproductive organs were presented [3,4]. Less than 10 years ago, some began questioning the value of this "best" practice [5]. In this column we address a few basic questions about the efficacy of gonadal contact shielding.

Do accurately placed shields reduce the dose received by reproductive organs? A gonadal shield on an adult male phantom reduced the dose to the testes during manual pelvic exposures by 36% in a recent study (from 254 to 186 μGy, a savings equal to 8 days of natural background radiation) [6]. The shield reduced the dose from primary x-rays, but the majority of the gonadal dose is from internal scatter radiation, unaffected by the shield. Furthermore, as the gap between the shield on the surface of the body and the gonads increases, the ratio of scatter to primary dose to the gonads increases. This reduces the effectiveness of a shield for the ovaries at a depth below the surface. This problem is compounded by the variance in the actual location of the ovaries within the abdomen [7]. These data suggest that the effectiveness of the shield for the ovaries may be less than 20%.

Can a shield be placed accurately over the reproductive organs without interfering with critical anatomy? Anatomic variance in the location of the ovaries does exist, and accurate placement of shields is challenging [7]. However, the testes can be accurately located and shielded; a recent article concluded that the continued shielding of adult male gonads during radiologic imaging of the pelvis remains a best practice [6]. For both genders, the need to repeat an exposure because the shield obscured critical anatomy results in increased dose to the patient.

Is gonadal shielding effective when automatic exposure control (AEC) is used? The majority of radiography today, except for children younger than 5 years, is performed using AEC. The exposure automatically terminates when a predetermined radiation dose is received by sensors in front of the image receptor. This manages the radiation dose to the patient required to provide a good-quality image. If the shadow of gonadal shielding impinges on the AEC sensor to any degree, attenuation of x-rays that should have reached the AEC sensor occurs. The machine reacts by extending the exposure, which increases the radiation dose to the patient. A recent study [8] verified that increases in dose to the stomach or iliac crest were as great as any decreases to the reproductive organs.

How radiosensitive are reproductive organs? The consensus opinion among radiation biologists regarding this question has shifted. The risk for hereditary effects in humans, based on animal models because genetic effects in humans have never been observed, is lower than previously believed [9]. The International Commission on Radiological Protection [10], in response, reduced the tissue weight factor for the gonads from 0.2 to 0.08 in Publication 103. The weighting factor of the colon, stomach, and bone marrow is currently 0.12 because these abdominal organs are believed to be more radiosensitive than the gonads. Logically, the organs assigned the highest radiosensitivity (highest tissue weighting factor)—bone marrow, colon, lung, stomach, and breast—would need to receive priority with respect to shielding.

Is there a psychological benefit from the use of contact gonadal shields for "radiation protection"? Some patients and/or their parents expect to be shielded when imaged. "Peace of mind" was derived from shielding practices during their previous imaging. These patients may have been told that shielding provided important protection during their examinations. This may cause

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many patients to react negatively if gonadal shielding is discontinued without explanation. However, continued routine shielding perpetuates the notion that we are taking active measures to protect patients when in fact we are providing psychological comfort with often negligible radiation protection benefit.

So how do we deal with this conundrum? A traditional "best practice," which is not as effective as we once thought, may need to be altered or discontinued. Careful communication with all parties involved is necessary to foster effective change. Radiologists and technologists need information on how changes in imaging practices, technological advances in radiography, and changes in the assigned radiosensitivity of different organs may have caused a previous "best" practice to become outdated.

Changing a "tradition" is not easy, especially when our patients value consistency and tradition. Our patients are simply expecting, as they should, the best care we can provide. Just as we need to educate ourselves about the true merits of gonadal shielding, we need to help our patients understand that their imaging experience should evolve as the field of imaging evolves to allow us to continue to deliver the best possible care.

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