

Nuclear Medicine Procedures Do Not Pose Cancer Risks in Women—Unappreciated or Otherwise

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We read with much interest the recent article by Biegon et al. in *Radiology* (1) and, with all due respect, found it to be devoid of competent radiation protection science or knowledge of radiation biology. In their first sentence, appealing to an uncritical acceptance of the conventional wisdom, the authors assert that “imagers and clinicians have known about the risks associated with radiation exposure for almost as long as we have existed as a specialty” and that “society overall has become increasingly cognizant that minimizing radiation exposure from medical imaging is a pressing need.” Further, according to the authors, the sources of radiation exposure in diagnostic radiology and nuclear medicine are associated with a “theoretic” increase in cancer risk, more so for nuclear medicine than for radiologic imaging.

This is all unfounded speculation as, despite the conventional wisdom, there is no documented evidence indicating any risk from the low-dose radiation exposure associated with medical imaging, for men or women (2–4). The authors’ further contentions, that hormonal changes associated with the menstrual cycle are an “avoidable source of vulnerability and risk” and that nuclear medicine “poses a disproportionate risk of adverse effects in women of reproductive age,” also lack evidence and are without merit.

The authors are silent on the disproven hypothesis behind these concerns, namely the linear no-threshold (LNT) description of radiation carcinogenesis that claims that all acute ionizing radiation exposure down to zero is harmful proportionally to dose and that it yields cumulative harm throughout life, regardless of how low the dose *rate*. There are documented risks at high radiation doses delivered acutely, but not at lower doses (<100–200 mGy) because the body is able to respond to any damage by various repair or elimination mechanisms (5,6). Low-dose risk is only *inferred* from linear extrapolation of the risk at high doses, an entirely unwarranted extrapolation given that the body responds

differently to high- and low-dose exposure (2,3). The authors even admit—referencing the Biologic Effects of Ionizing Radiation (BEIR) VII report, one of the most widely cited sources (albeit *in support of LNT*)—that “the risks of diagnostic nuclear medicine procedures using relatively short-lived isotopes could be viewed as mostly hypothetical.” Thus, the risk the authors repeatedly invoke is only hypothetical and has never been observed.

The authors appear to assign greater risk to nuclear medicine imaging studies than to diagnostic radiologic procedures because dose reduction is “harder” to achieve. Both are patently false. Further, the usual justification for the need for dose reduction is that it errs on the side of caution; however, for radiologic imaging, significant negative consequences of lowering dose arise. Reducing patient doses to mitigate purely hypothetical cancer risks reinforces other risks that are nonhypothetical—those resulting from fear of imaging, including imaging avoidance; subdiagnostic image quality; and use of alternative imaging procedures, such as a longer-duration MRI study, requiring risk-incurring sedation for young children (3). The risks of misdiagnoses from inadequate dose could be much higher than the cancer risks that even LNT (falsely) predicts and that are putatively avoided by dose-reduction strategies. There is no safe side on which to err when empiric science is rejected.

It is important to note that the radiation dose associated with nuclear medicine studies is protracted and delivered at a much lower dose *rate* than that from CT, and therefore any alleged effects would be even less in the face of empirically documented repair or elimination processes. There are, in fact, no data in existence to confirm the baseless hypothesis that the radiation doses from *diagnostic* radiopharmaceuticals cause harm to any organs of women—or men!

The authors then go on to erroneously conflate diagnostic nuclear medicine with radionuclide therapy, treatments associated with much higher doses given for the purpose of killing abnormal cells, as is the case for radiation oncology.

The title of their article ends in a question: “Unappreciated Risks to Reproductive Organs?” The answer is already at hand if one critically seeks it. No, low-level radiation-absorbed doses associated with diagnostic nuclear medicine pose no risks to reproductive organs, or any other organs, in women or men.

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