International Journal of
Radiation Oncology
biology • physics

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Report

Heavy PETting: Reducing Radiation Exposure From Intradepartment Positron Emission Tomography Scans

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Received Nov 5, 2013, and in revised form Nov 5, 2013. Accepted for publication Nov 7, 2013.

Increasingly, positron emission tomography (PET) scans are being utilized in radiation medicine departments for staging, treatment planning, and follow-up. Positron emission tomography scans use signals emitted from the radioactive tracer [^{18}F]-fluoro-2-deoxy-D-glucose (FDG-glucose) that is preferentially taken up by cancer cells. After image processing including fusion with simultaneously obtained computed tomography (CT) scans, the oncologist is able to identify tumors as they "light up." Positron emission tomography scans are becoming a part of standard oncologic evaluation for many cancers for which their sensitivity and specificity for cancer detection is superior to CT scans. Positron emission tomography is used frequently at the time of simulation because treatment planning can be tailored by targeting areas of metabolically active tumor. Given the sensitivity of PET in cancer detection, it is being used increasingly as part of standard follow-up to evaluate response to treatment, to detect early recurrent or persistent disease, and to help differentiate radiation necrosis from tumor. With all these useful applications in our cancer patients, the number of PET scans ordered has risen significantly in the last few years. For example, taking just the US Veterans Administration patients treated in our department, the number of PET scans ordered increased from 100 scans in 2008 to 811 in 2012.

This presents a new and unique problem in radiation protection. The FDG-glucose is administered intravenously at a typical dose of 5-10 mCi directly before scanning, and it remains in a patient's circulation for several hours after administration, with a physical half-life of 110 minutes. The biologic half-life is dependent on urinary excretion. Given patient anxiety in cancer detection and the fact that PET scanners are often located in close proximity to the ordering radiation oncologist, physician visits are often scheduled directly after PET scans are completed, often for the direct purpose of reviewing the PET study.

We surveyed 15 patients in our department directly after their PET scans were completed and found their average radiation exposure was 3 milli-Roentgens per hour at 1 meter and 15 milli-Roentgens per hour at 6 inches. Estimating a half-hour office visit and 3 patients seen after PET per week for each provider, this would result in approximately 2 mSv at 1 meter and 10 mSv at 6 inches annually. According to the National Council on Radiation Protection and Measurements guidelines, annual limits for radiation workers in the United States are set at 50 mSv. (This limit drops to 5 mSv if the radiation worker is pregnant.) Thus, PET scan exposure on its own may approach radiation exposure limits.

Radiation medicine departments with PET scanners need to be conscious of this insidious route of radiation exposure and apply the guidelines of ALARA [as low as reasonably achievable] to minimize unnecessary exposure. The 3 factors that control exposure are time, distance, and shielding. Time is the most straightforward factor in exposure reduction from PET scans. Given the relatively short half-life of FDG-glucose, mandating even a few hours between PET scan and office visit can significantly reduce exposure. Other measures could include reducing the time spent with patients after PET scans and increasing the distance between providers and patients after PET scans; however, these interventions could impair patient care delivery. We have made an effort to schedule office visits 6-24 hours after PET scans. Additionally, having patients void before office visits may maximize biological clearance and reduce exposure. The most important step to reduce exposure is to be aware of this potential hazard in the first place.

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Conflicts of interest: none.

Int J Radiation Oncol Biol Phys, Vol. ■, No. ■, pp. 1, 2013
0360-3016/$ - see front matter
http://dx.doi.org/10.1016/j.ijrobp.2013.11.015