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Personnel dose assessment during commissioning of the first hospital-based PET radiopharmaceutical cyclotron in Greece

The role of FDG in PET imaging is well established in the diagnosis and management of cancer patients. Small footprint cyclotrons that can be installed on-site are becoming popular worldwide and are an efficient solution for medium-size facilities. The dose-on-Demand Biomarker Generator (BG-75) was installed at Metaxa Cancer Hospital, Piraeus, Greece, in May 2021 and is the first hospital-based PET radiopharmaceutical cyclotron in the country. The system consists of an accelerator used in conjunction with a Chemistry Production Module (CPM). In the commissioning process, it was necessary to establish the expected external dose to personnel; internal exposure is not expected under normal conditions. Personnel includes operators (technologists), a radiochemist, and medical physicists. Among these groups, the highest exposure is expected in the operators' group. All personnel have been assigned TLD whole body and extremity dosimeters and have completed relevant radiation safety training. Also, operating training was provided by the cyclotron installation engineer. Personnel dose was estimated using two methods: survey meter measurements in various locations combined with the time spent in each location, and direct measurement using electronic personal dosimeters. It is estimated that approximately 8 patients (~4 cyclotron runs) will be performed every workday (5 days/week, 50 weeks/year). All gamma radiation readings outside the cyclotron vault were at background levels. Neutron readings were at background levels except for the reading in the hot lab, where 0.1 μSv/h was recorded close to the wall, which is still a negligible contribution to personnel dose. Inside the cyclotron vault, the highest recorded readings were 18 μSv/h for both gammas and neutrons close to the target; at one meter, the values were 5 μSv/h and 4 μSv/h, respectively. The estimated whole-body dose for 60 min runs for the two methods are 1.75 μSv (exposure rate method) and 2.44 μSv (personal dosimeter method). The respective extremity dose estimates are 65 μSv (exposure rate method) and 25 μSv (personal dosimeter method). The annual expected whole-body dose per operator is 0.6 mSv, and the respective extremity dose is 16 mSv. The annual expected whole body and extremity dose for the radiochemist is 0.3 mSv and 25 mSv, respectively. The respective annual dose estimates for the medical physicists are < 1 mSv. The expected doses for technologists/operators, radiochemists, and medical physicists are expected to be well below the regulatory limits and local ALARA levels. With experience and a robust ALARA program, personnel exposure could be further reduced.

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