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CT radiation exposure in multi-modality imaging

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During the last years, the use of multi-modality imaging instruments in the nuclear medicine department has increased significantly. Using CT in PET/CT and SPECT/CT enables both anatomical and functional images to be collected in a single imaging session. Unfortunately, CT acquisitions are mostly associated with a considerable patient radiation dose and, therefore, require appropriate justification.4

Patient CT doses depend on the selected scan protocol and the anatomical region being scanned. Using (non-optimized) diagnostic exposure factors, effective doses for whole body CT in PET/CT examinations may amount up to 25 mSv. As a result, the CT scan constitutes a significant additional radiation dose, compared to the dose attributed to the use of the radiopharmaceutical.

There is a strong need to optimize these diagnostic CT protocols by adjusting scan parameters such as tube current, pitch, tube voltage, collimation, slice thickness, etc.5 Optimization should be performed according to the level of quality needed to perform a specific diagnostic task. Further dose reductions can be obtained by the use of automatic tube current modulation and adaptive filtration techniques which become more and more available on PET/CT and SPECT/CT systems. Doing so, effective radiation doses from diagnostic whole-body CT scans can be reduced down to about 7 mSv.2

In most situations, the CT part of the scan does not need to be of diagnostic quality, as the CT images are only being used for localization of lesions or to generate attenuation maps. In the latter cases, CT exposure factors should be adjusted to significant lower values. Effective doses down to 1 mSv are reported in literature for whole-body low-dose CT protocols.2

The radiation dose delivered by CT is a major issue in pediatric applications, due to their higher radiosensitivity to ionizing radiation. When using serial CT scans for follow-up, the cumulative effective dose may become very high. In the latter case, special attention should be paid to the adjustment of the scanning parameters according to the size of the patient and, especially in the case of follow-up, the use low-dose protocols whenever possible.

References