Dose Optimisation in Paediatric Radionuclide Imaging

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Paediatrics means the age group 0-18 years. This distinction in medicine is widely justified, being the human body growing and maturing roughly up to this age. Growing tissues are more sensible to the mutagen effect of ionizing radiation; this is why children and adolescents are much more sensible to radiation damage than adults. Using the actual system of risk estimate, the risk of having a solid tumour after exposure is about 3 times higher for a 1-year-old child and 1.8 times higher for a 10 years-old child in respect to an adult[1]. Females are moreover charged of a 50% increase in relative risk. [ICRP 103]. Children then definitely require the maximum attention in balancing exposure against the benefit expected from the diagnostic procedure, i.e. the clinical information get. The exposure in NM is directly related to the administered activity of the radiopharmaceutical (RPh); so, for calculating paediatric activities, the Paediatric and Dosimetry Committees of the EANM set out the EANM paediatric dosage card, last updated in 2014[2].

[http://www.eanm.org/publications/dosage_calculator.php?navId=285].

Beyond administering low and, when possible, lower activities, there are other synergic, safe and simple ways for further reducing the radiation burden: to stimulate RPh elimination by generously drinking and frequently voiding and changing the diapers; by standardization of low-dose CT protocols in SPET/CT and PET/CT imaging[1], by exploring the possibilities offered by improvements of hardware and software, where enhanced planar processing[3] and iterative reconstruction with resolution recovery[4] seem the most promising tools.

Take-Home Messages

The process of dose optimization and reduction, namely in Paediatric Nuclear Medicine, is a comprehensive one[5]; practical approach to dose reduction implies then:

- To be compliant with the individual justification process, and perform only studies able to change the clinical management, especially dealing with benign diseases;
- To use basically the activities calculated according the EANM Paediatric dosage card;
- To stimulate the elimination of RPh by urine or stools;
- To careful evaluate the impact of newer hardware/software technologies.

References:

1 Gelfand MJ. Dose reduction in pediatric hybrid and planar imaging. *Q J Nucl Med Mol Imaging* 2010;54:379–388.

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3 Hsiao EM, Cao X, Zurakowski D, Zukotynski KA, Drubach LA, Grant FD, et al. Reduction in radiation dose in MAG3 renography with enhanced planar processing. *Radiology* 2011;261:907–915.

4 Stansfield EC, Sheehy N, Zurakowski D, Vija AH, Fahey FH, Treves ST. Pediatric 99mTc-MDP bone SPECT with OSEM iterative reconstruction with isotropic 3D resolution recovery. *Radiology* 2010;257:793–801.

5 Fahey FH, Treves ST, Lassmann M. Dose optimization in pediatric nuclear medicine. *Clin Transl Imaging.* 2016. [online] doi:10.1007/s40336-015-0153-8