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Letter to the Editor re: Spectral Hounsfield units – a new radiological concept

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Modified units for computed tomography

We read with interest the recent paper in your journal by Hurrell et al.[1]. In this paper, they observed that in spectral CT measurements of materials such as iodine, iron, calcium and oil in a phantom using their Medipix-based system, the attenuation of the samples was highly dependent on the X-ray energy window. This corresponds with our observations of gold and iodine contrast media using both a conventional CT system run at different voltages and a spectral CT system[2; 3]. These results are due to the characteristic X-ray attenuation profiles of different materials,[4] with K-edge absorbances having a large effect, in particular.

In the conclusions to their paper, Hurrell et al. proposed a modified scale of Hounsfield Units, termed spectral HU, to account for the differing attenuation at different energies, where a subscript denoting the mean energy used is appended, e.g. 400 HU_{90}, when the mean energy used is 90 keV.[1] We support this new scale of Units in principle. However, it seems to us that the use of solely the mean energy to denote the attenuation will be insufficient. For example, HU_{90} could equally refer to a voltage window of 80–100 keV or 20–160 keV. It is likely that a material will have differing attenuation in these two windows. Therefore we suggest the use of the energy window in the subscript, e.g. 400 $HU_{80–100}$.

Lately, we and others have developed a variety of novel CT contrast agents based on nanoparticles[3; 5–9]. Furthermore, in a recent paper we proposed the use of a unit to denote the performance of CT contrast agents, i.e. attenuation rate (attenuation per unit concentration, given in HU/mM).[2] As mentioned, these attenuation rates were found to be highly dependent on the X-ray tube voltage used. In light of the above discussion, it seems that attenuation rates should be given with subscripts denoting the X-ray voltages in question, i.e spectral attenuation rates should be used. For example, $HU_{80–100}$/mM should be used to describe contrast agent performance in a 80–100 keV window. Adoption of spectral HU and spectral attenuation rates should provide a framework for evaluating contrast with spectral CT or dual energy CT, the easy comparison of novel contrast agents and swifter advancement of the field.

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Key points

- Dual energy and spectral CT are novel techniques becoming more widely available.
- These technological advancesrequire a new attenuation scale: spectral Hounsfield Units.
- We suggest a modification to this new attenuation scale proposed by Hurrell et al.
- We also propose a new scale for assessing novel CT contrast media.