Letter to the editor.

The number of subsets required for OSEM reconstruction in nuclear cardiology.

The European Association of Nuclear Medicine (EANM) and the European Society of Cardiology (ESC) have brought together their expertise in order to develop guidelines for myocardial perfusion imaging in nuclear cardiology. The result [1] is a very rich text with a lot of highly useful clinical and technical details.

In the eighth section, dealing with reconstruction methods, it is stated that "although FBP is probably still (2004) the most frequently used method of SPECT reconstruction, it is rapidly losing ground to the iterative techniques". This section gives an excellent introduction to both FBP and MLEM/OSEM reconstruction methods. However, it is our opinion that one parameter of the utmost importance for correct use of OSEM is not well documented.

OSEM [2] can be viewed as a "trick" to accelerate the MLEM algorithm. The trick consists of grouping the projections into small sets to form subsets. Although there are several ways to realize the grouping, commercial algorithms propose only one method and no alternative is available to the user. There are however two parameters that should generally be fixed by the user. The first is, as in MLEM, the number of iterations (i). The second is the number of projections per subset, or the equivalent number of subsets (s). As stated in the guidelines [1], the convergence of the OSEM algorithm is not theoretically demonstrated, whereas the convergence of MLEM is. It is however a common experience that i OSEM iterations with s subsets deliver images very close to those generated by i x s MLEM iterations [3]. The main advantage is a gain in processing time roughly equal to the number of subsets [1]. The now ten year old experience with OSEM has shown that the subsets should contain at least a minimum of 4 projections. With fewer projections per subset, the OSEM algorithm is more likely to diverge. This means a maximum of 8 subsets for 32 projections, 16 subsets for 64 projections and 32 subsets for 128 projections. The number of subsets is given neither in the guidelines [1], nor in the text, nor in Table 11. In Table 11, 10-15 MLEM iterations and 1-2 OSEM iterations are recommended. From these two sets of data and the above-mentioned rule of equivalence between OSEM and MLEM produced images, it could be inferred that the recommended number of subsets should be 8-16. However it needs to be borne in mind that more than 8 subsets is not suitable for 32 projections.

In summary, it could be recommended that the inexperienced user always use 8 subsets and at least 2 iterations for OSEM reconstruction of SPECT myocardial perfusion images. The user should nevertheless also be made aware that such a low number of iterations would generate reconstructed images with a low noise level, but at the expense of a biased contrast [4]. In other words, a low number of iterations results in smooth images, but with a low contrast, especially in low perfused regions [4,5].

Furthermore in light of the ever-increasing computer performance, it could be questioned whether OSEM should still be used in SPECT when no correction (attenuation, scatter, resolution) is performed.

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References.

1. Hesse B, Tägil K, Cuocolo A, Anagnostopoulos C, Bardiés M, Bax J et al. EANM/ESC procedural guidelines for myocardial perfusion imaging in nuclear cardiology. *Eur J Nucl Med Mol Imaging* 2005; 32:855-97.

2. Hudson HM, Larkin RS. Accelerated image reconstruction using ordered subsets of projection data. *IEEE Trans Med Imaging* 1994;13:601-9.

3. Hutton BF, Lau YH. How critical is subset balance for OSEM reconstruction in myocardial SPECT ? *J Nucl Med* 1997;38:57P.

4. Hutton BF, Hudson HM, Beekman FJ. A clinical perspective of accelerated statistical reconstruction. *Eur J Nucl Med* 1997;24:797-808.

5. Seret A. Number of iterations when comparing MLEM/OSEM with FBP. *J Nucl Med* 2004;45:2125.