

7c

## Issues in quantification in nuclear cardiology

H. J. Verberne (Amsterdam)

Single-centre experiences do not necessarily allow for extrapolation of the obtained results to other centers. In spite of this, quantitative thresholds are often implemented without inter-institutional validation. Because there are differences between centers in hardware, acquisition parameters and post-acquisition processing, the extrapolation to other centers, or generalization of these single-center findings, is not per se justified. Especially due to the lack of well defined data sets, validation in each separate center and between centers has not been possible. Recently, a realistic 3D gated cardiac phantom, the Amsterdam gated cardiac phantom (AGATE phantom), was developed and validated.<sup>1</sup> Such a phantom could be used as a tool for the validation in each separate center and standardization between centers. However, a phantom can only partially simulate patient characteristics. Therefore, the phantom results obtained will give only an impression of repeatability and variability, but they do not necessarily reflect the accuracy of measurements in patients. Therefore, in addition to the phantom measurements, a set of reference patient studies should also be included in a validation of the technique.<sup>2</sup> Moreover, the results should be validated in each separate center, and monitored for reproducibility and consistency. In this CME the impact of these prerequisites will be illustrated for 2 major areas of Nuclear Cardiology: myocardial gated perfusion SPECT and myocardial <sup>123</sup>I-meta-iodobenzylguanidine (MIBG) scintigraphy for the assessment of cardiac sympathetic activity.

The combination of function and perfusion data from myocardial gated perfusion SPECT has led to the widespread use of this technique in clinical practice. The SPECT derived left ventricular volumes are used to calculate left ventricular ejection fraction (LV EF). In a multi-center intercomparison study, using the AGATE phantom, the variation in volumes and therefore ejection fractions between the different centers was considerably greater than the single-center reproducibility and variability.<sup>3</sup> Therefore, care should be taken before extrapolation of published and accepted cut-off values for LV EF and volumes in clinical decision making.

Despite the large number of studies on cardiac <sup>123</sup>I-MIBG imaging, methodological and analytical limitations have hampered large scale implementation of this technique for the evaluation and management of individual patients.

For myocardial <sup>123</sup>I MIBG, quantification is obtained from anterior planar images by the use of the ratio between a myocardial region of interest (ROI) compared to a mediastinal ROI. This so called heart-to-mediastinal ratio (H/M) can be obtained from early images (15 min after injection of <sup>123</sup>I-MIBG) and late images (4 h after injection). Myocardial washout of <sup>123</sup>I-MIBG can be calculated as the difference between the early and the late H/M expressed as a percentage of the early H/M. Within individual centers <sup>123</sup>I-MIBG has been shown to have both good reproducibility, acceptable variability, and to have prognostic value in patients with heart failure. Differences in collimator type (low energy or medium energy) and image acquisition time substantially influence values and accuracy of the measured <sup>123</sup>I-MIBG myocardial ratios. Moreover, a rigorously and uniform definition and placement of the ROIs for the calculation of the myocardial <sup>123</sup>I-MIBG ratios minimizes inter- and intra-individual variation.

In conclusion, care should be taken before applying published and accepted cut-off values in clinical decision making. Results should be validated within each center and between centers and monitored for accuracy and consistency over time.

### References

1. Visser JJ, Busemann Sokole E, Verberne HJ, Habraken JB, van de Stadt HJ, Jaspers JE, Shehata M, Heeman PM, van Eck Smit BL. A realistic 3-D gated cardiac phantom for quality control of gated myocardial perfusion SPET: the Amsterdam gated (AGATE) cardiac phantom. *Eur J Nucl Med Mol Imaging*. 2004;31:222-228.
2. Britton KE, Busemann Sokole E. COST B2: why and wherefore. *Eur J Nucl Med*. 1992;19:563-568.
3. Verberne HJ, Dibbets P, Spijkerboer A, Stokkel M, van Eck – Smit, Busemann Sokole E. Multicenter intercomparison assessment of consistency of left ventricular function from a gated cardiac SPECT phantom. *J Nucl Cardiol* 2006;13:801-810.