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How to use attenuation correction in myocardial perfusion SPECT

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Myocardial perfusion scintigraphy (MPS) is a frequently used effective diagnostic test to identify patients with symptomatic or asymptomatic coronary heart disease, to risk stratify asymptomatic and symptomatic patients before and after therapeutic interventions, and to test viability in patients with ischemic cardiomyopathy. [1, 2] The most frequent and difficult cause of imaging artifacts is related to tissue attenuation of the emitted photons, which result in a typical image degradation. Artificial diminished activity presentation was found predominantly in the inferoseptal basal and anteroseptal apical wall making the final diagnosis in these regions often difficult. The result is a more pronounced loss of specificity than that of sensitivity performing myocardial perfusion imaging without correction for that artifacts.

Gated-SPECT allows – in addition to the generation of functional and volumetric parameters of the heart – the analysis of regional wall thickening during the heart cycle and therefore can help substantially to identify attenuation artifacts and improve specificity of the MPS [2]. Another approach to minimize the effect of attenuation is the prone scanning with regard to inferolateral artifacts. Furthermore, a quantitative analysis with a comparison to a reference database allows to some degree a population-based compensation for tissue attenuation. Nevertheless, not all attenuation problems can be addressed sufficiently and reliably [3].

To overcome these limitations a variety of techniques have been developed to apply a correction for tissue attenuation to the emission data. A transmission scan either with an external radionuclide source – filled with isotopes like Gd-153, Co-57, Ba-133 or Tc-99m – or an x-ray CT in combination with a blank scan provides a map with attenuation coefficients (μ-map) to compensate the attenuation artifacts. Different acquisition schemes (simultaneous, sequential) and durations of the transmission scan have been applied [3, 4].

Clinical studies including multicenter-trials could demonstrate a substantial improvement in diagnostic quality using attenuation corrected MPS. The specificity improved of about 15 % with a nearly unchanged sensitivity. A higher certainty of the reader enabled more stress only studies to exclude a significant coronary heart disease. Main LCA and multi-vessel-disease could be identified easier and with a higher sensitivity. Combining gated SPECT with attenuation correction yield additive effects improving the use of MPS further [3, 4]. Based on these encouraging results a recommendation was given to use attenuation correction on a routine basis [5].

New technical developments include the results of the transmissions derived μ-map in the reconstruction process together with a scatter correction, and a correction for the depth dependent loss of resolution due to the collimator. Although up to now larger clinical trials using this new technology are missing, the image quality achievable with these new correction techniques is remarkable.

In the presentation the properties of the actual commercially available attenuation correction devices were demonstrated. Practical advices were given how and in which situation the attenuation correction should be applied with MPS. Recommendations for the clinical praxis on the basis of the actual guidelines were provided.

References

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