Quality Control for Attenuation Correction

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The diagnostic accuracy of single photon emission computed tomography (SPECT) myocardial perfusion imaging is influenced by the presence of tissue attenuation. Attenuation correction represents an innovative development for myocardial perfusion SPECT and significantly improves the specificity of the test. It is also reported that attenuation correction also improves outcome prediction.

Various attenuation correction algorithms are described; fixed line source with convergent collimation on triple-detector systems, scanning line source with parallel-hole collimation on dual-detector 90° systems, multiple line source array approach with parallel-hole collimation on dual 90° systems and recently X-ray tube-based technology on hybrid SPECT/CT systems. However, regardless of the techniques used for acquiring the attenuation map high quality transmission data is required. This data is defined as; near-uniform attenuation coefficients across the mediastinum, no truncation artefacts, well-defined lung boundaries and breathing cycle equivalent to a free breathing state averaged over several respiratory cycles.

Quality control of attenuation correction performance should include the following verifications: uniformity, variability and temporal drift of the reference transmission scan; consistency of hardware performance; pre-scanning methods to ensure adequate transmission scan counts; and algorithms that assist the technologist and physician in assessing the sufficiency of the data. In particular, count densities must be sufficient enough to overcome the intrinsic inconsistencies of scans with poor signal-to-noise ratios. Prior to interpretation, all transmission data sets should be routinely inspected for image quality. Other important quality control parameter related to the accurate registration of attenuation maps and emission data is gating artefacts unique to attenuation correction processing.

CT based reliable attenuation maps (mu-maps) of the thorax can be obtained even with the use of very low tube current. On CT based attenuation correction critical misalignment may significantly alter the attenuation map. Recently, some automatic algorithms are described to overcome this problem. In various clinical circumstances attenuation correction may overcome but may also create some artefacts. Over correction or under correction of the emission data is the major dilemma. It is most important that the attenuation maps should always be viewed and checked for artefacts. Furthermore, quality control of transmission data and attenuation-corrected reconstructed images should be performed for each patient and interpreted in comparison with non-corrected conventional images. Quality control issues should be considered seriously.

References


