RESOLUTION ENHANCEMENT AND ACQUISITION TIME REDUCTION IN SPECT APPLICATIONS:THE WIDE BEAM RECONSTRUCTION METHOD

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Objectives: The implementation of a novel reconstruction method of Wide Beam Reconstruction (WBR) is evaluated in two leading SPECT applications. The WBR is based on an accurate physical description of the acquired data and on its reconstruction, utilizing iterative optimization methods.
The objectives are to apply this method to (1) bone SPECT to improve reconstructed image resolution by 30% or more and (2) cardiac SPECT to obtain comparable or better image quality at a substantially shorter acquisition time.
Methods: Two protocols were used and the data was reconstructed with the WBR method. The High Resolution (HR) protocol is based on accepted clinical acquisition protocols. The High Sensitivity (HS) protocol utilizes a specially designed collimator which is about 4 times more sensitive than typical collimators. Except for decreasing the acquisition time, no changes are made to the clinical acquisition parameters. These protocols were adapted to several existing gamma cameras and compared with the widely used FBP method. Several phantom studies were acquired for the quantification and comparison of system resolution and sensitivity, lesion detectability and image contrast. A further comparison of limited patient data has been conducted to evaluate the benefits of the WBR technique.
Results: The WBR-HR demonstrates a 30% improvement in resolution (measured in FWHM), over the commonly used reconstruction method. In addition, the dependence of the resolution on distance from the collimator was noticeably less than that of FBP E.g., for a High resolution cast collimator, the FBP and WBR methods showed resolution degradation of 0.4 and 0.1mm per increased distance of 1cm, respectively. The WBR-HS phantom studies retained image resolution similar to the commonly used clinical protocol, while decreasing acquisition time 4 fold (a 4 minute acquisition). The artifact in the apex that is associated with the 180 degree FBP method is reduced with the new method.
Conclusions: Images reconstructed using the WBR-HR protocol provide improved resolution to those reconstructed by current methods in use. Images acquired and reconstructed using the WBR-HS protocol provide image quality comparable or better than the typical cardiac perfusion protocol that utilizes FBP, at an acquisition time that is 1/4 of the latter.