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Predicting human performance by channelized Hotelling observer in discriminating between Alzheimer's dementia and controls using statistically processed brain perfusion SPECT

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Objective: We compared the diagnostic accuracy achieved by a human observer (nuclear medicine physician) and a channelized Hotelling (CH) observer on the basis of receiver-operating characteristics (ROC) curve for the differential diagnosis of Alzheimer's disease (AD) from SPECT images. ***Methods:*** The I-123-IMP brain perfusion SPECT images of 42 subjects (21 AD patients and 21 healthy controls) were used for an interpretation study and those of 10 healthy subjects were for a normal database. SPECT images were processed into four types: original SPECT images, three-dimensional stereotactic surface projection (3DSSP) images derived from them, Z-scores of SPECT images, and Z-scores of 3DSSP images. Five nuclear medicine physicians evaluated the test dataset sequentially as to whether the presented images were those of AD patients, which were rated using five categories of certainty: definitely, possibly, equivocally, possibly not, and definitely not. The test statistics (λ) of the dataset generated by the CH observer were rated for ROC analysis. The areas under the ROC curves (Az) for the four image types interpreted by the human and CH observers were estimated and compared. ***Results:*** Among the four image types, the best performance based on Az obtained by both the CH and human observers was observed for the Z-score of 3DSSP images, and the lowest was for the original SPECT images. ***Conclusions:*** The performance of the CH observer was similar to that of the human observers, and both were dependent on the image type. This indicates that the CH observer may predict human performance in discriminating Alzheimer's dementia and can be useful for comparing and optimizing image processing methods of brain perfusion SPECT without human observers.

Key words: channelized Hotelling observer, Alzheimer's disease, single-photon emission tomography, ROC analysis, three-dimensional stereotactic surface projection