

Automated MRI Detection and Characterization of Hyperacute Stroke

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Introduction: In acute stroke patients timely and optimized therapeutic intervention is critical for positive outcome. Treatment decisions hinge upon the rapid accurate detection and categorization of brain ischemia, the latter to include age, perfusion-diffusion mismatch and hemorrhage. MRI with diffusion sequencing can rapidly image strokes in evolution within one hour of ictus. However MRI stroke detection, characterization and quantification is time and labor intensive, requiring a trained neuroradiologist. Given that “time is brain”, a computer automated algorithm to evaluate MRI stroke images as they are obtained may have great clinical utility. **Rational:** A computer algorithm can be developed to rapidly identify and characterize ischemic areas with both high sensitivity and specificity, positively impacting treatment decisions and patient management. **Methods:** The detection algorithm was developed on MR images of 5 patients who had suffered ischemic strokes. The images acquired from the scanner are first pre-processed to optimize the performance of the detection algorithm. The pre-processing involves existing software which performs the tasks of file conversion and condensation, brain extraction, motion correction and co-registration. The detection algorithm works by exploiting the fact that ischemic or infarcted brain has an idiosyncratic appearance on certain types of images. While other image types have been considered to improve the specificity of the algorithm, the two of principal interest are the diffusion-weighted image (DWI) and the mathematically derived apparent diffusion coefficient (ADC). Ischemic areas appear bright (high intensity) on DWI images and dark (low intensity) on ADC map, indicative of restricted diffusion and cytotoxic edema. In essence, the algorithm makes a pixel by pixel comparison of these two images types slice by slice and records a hit when both the DWI and ADC pixel match intensity threshold criteria. Optimal intensity thresholds differ between data sets and their selection has been a product of both heuristically obtained fixed values and linear optimization by a neural network. **Results:** As one could speculate, the performance of the detection algorithm is extremely susceptible to the specific values of the intensity thresholds. At present the algorithm displays high sensitivity in that it consistently registers the ischemic area where an infarct is known to develop. However the specificity is low as what constitutes the algorithm’s positive signal is consistently laden with non-stroke artifact. **Conclusions:** Further algorithm refinements are required to achieve the high level of sensitivity and specificity required to make our computer program clinically viable. The potential impact on health care is great and continued efforts are warranted.