

Computer aided FCD lesion detection based on T1 MRI data

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Rationale

Focal cortical dysplasia (FCD) is a frequent cause of epilepsy and can be detected using brain magnetic resonance imaging (MRI). The FCD lesions in MRI images are characterized by blurring of the gray matter/white matter (GM/WM) junction, cortical thickening and hyper-intensity signal within lesional region compared with other cortical regions. However, detecting FCD lesions by means of visual inspection can be a very difficult task for radiologists because the lesions are very subtle. To assist physicians in detecting the FCD lesions more efficiently and reduce the false positive regions resulted from the existing methods [1], we propose an algorithm for automated FCD detection based on T1 MRI data.

Methods

The proposed computer aided diagnosis (CAD) technology mainly contains the measurement of difference in feature values of subject and healthy controls (DFSH) and classification using the Combination of Multiple classifiers (CMC) method, and is called DFSH-CMC. To increase the difference between FCD and non-FCD regions, the feature maps including gray matter thickness map, gradient map, relative intensity map and gray/white matter boundary width map are computed from the T1 MRI data of 41 subjects (10 patients and 31 healthy controls). The DFSH maps are measured after registering all data into a standard space. Different single (not combined) classifiers are applied for classifying voxels of MRI data into FCD (positive) or non-FCD (negative): naive Bayesian, linear discriminant analysis (DA), quadratic DA and Mahalanobis DA classifiers. To lower the number of false positive (FP) voxels resulted from the single classifiers, we utilize the CMC method to reclassify the voxels classified as positive by the single classifiers. Each subject is classified as a patient if the subject's image has voxels classified as FCD, otherwise, as a healthy control.

Results

The proposed method has correctly identified 8 out of 10 FCD patients and 30 out of 31 healthy controls. Compared to the feature maps, the DFSH maps are able to better differentiate between FCD and non-FCD regions. The single classifiers could correctly identify voxels within FCD regions as positive, but the number of FP voxels is large. Using CMC method, most of FP voxels resulting from the single classifiers are correctly reclassified as negative.

Conclusions

The proposed DFSH-CMC algorithm shows promise to become a valuable tool for automated detection of FCD lesions based on T1 MRI data. In future, the detection of FCD lesions using the multi-modal MRI data (e.g. fluid attenuated inversion recovery MRI and T1 weighted MRI) will be considered for further improving the FCD detection performance of the DFSH-CMC.

References

[1] Antel S. B., Collins D.L. and Bernasconi N. et al, "Automated detection of FCD lesions using computational models of their MRI characteristics and texture analysis", *NeuroImage*, 19(4),1748-1759, 2003.