AN MRI-BASED MACHINE LEARNING DERIVED BIOMARKER IN DIFFERENTIATING FRONTOTEMPORAL DEMENTIA FROM ALZHEIMER'S DISEASE

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Introduction

- Due to their overlapping symptoms and different treatment strategies, there is a great unmet need for establishing a feasible and accurate method in differentiating frontotemporal dementia (FTD) from Alzheimer's disease (AD).
- Machine learning showed great potential in detecting characteristic brain atrophy patterns based on structural magnetic resonance imaging (MRI), which can be a powerful tool in FTD diagnosis. We aim to derive a novel FTD-AD differentiation index by support vector machine (SVM) learning algorithm and develop an MRI-based differential diagnosis strategy.
- However, the requirements of manual image post-processing and mass calculation make traditional algorithm less feasible in clinical application.
- We aim to derive a novel FTD-AD differentiation index by support vector machine (SVM) learning algorithm and develop an MRI-based differential diagnosis strategy.

Methods and Materials

- 91 FTD subjects and 40 cognitive unimpaired (CU) subjects were recruited from the Frontotemporal Lobar Degeneration Neuroimaging Initiative (FTLDNI) database. 99 AD subjects were recruited from Alzheimer's Disease Neuroimaging Initiative (ADNI).
- AD resemblance atrophy index (AD-RAI) and FTD resemblance atrophy index (FTD-RAI) were generated by automatic segmentation using AccuBrain® IV 2.0 (BrainNow Medical Technology Company Ltd.).
- Based on the brain volumetric data of both FTD subjects and AD patients, we used the SVM learning algorithm to compute and select the most relevant brain regional volumetry and project the multi-dimensional brain regional volumetry features into a single atrophy index (FTD-AD index) for the differentiation of FTD and AD.
- In our diagnostic protocol, we follow the two-step process: First, we use AD-RAI and FTD-RAI to differentiate AD or FTD from CU subjects with a cut-off of 0.5 for both indexes, respectively. After then, if both ADRAI and FTDRAI achieved more than 0.5, then we use the FTD-AD index to differentiate FTD from AD.

Results

- Overall, 230 subjects were enrolled (age range from 39 to 90, mean 68.71±9.33, 52.6% male)
- ADRAI had great discrimination ability in differentiating AD from CU with an AUC of 94.4%.
- FTDRAI showed excellent accuracy in identifying FTD from NC with a sensitivity of 89.9%, a specificity of 85.0%, and an AUC of 97.0%.145
- (63.0%) subjects presented both FTD-RAI and AD-RAI more than 0.5. Among those subjects, the FTD-AD index yielded perfect discrimination performance with a sensitivity of 97.0%, a specificity of 96.2%, and an AUC of 98.9%.
- The final classification results based on the two-step process showed great accuracy of 90.0%.

Conclusions

By combining of AD-RAI, FTD-RAI and a novel FTD-AD differentiation index, it might help to establish a feasible differential diagnosis strategy of FTD and AD in clinical practice.

Table 1. ROC analysis of differentiating AD from NC (n=139)

Variables	Cutoff	AUC	95%CI	Sensitively	Specificity
ADRAI	0.535	0.944	0.892-0.976	0.879	0.950

Table 2. ROC analysis of differentiating FTD from NC (n=131)

Variables	Cutoff	AUC	95%CI	Sensitively	Specificity
FTDRAI	0.573	0.970	0.877-0.968	0.899	0.850

Table 3. ROC analysis of differentiating FTD from AD in those subjects with both ADRAI and FTDRAI >0.5 (n=145 FTD=67 AD=78)

Variables	Cutoff	AUC	95%CI	Sensitively	Specificity
FTD-AD index	0.192	0.989	0.955-0.999	0.970	0.962

REFERENCE

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