ALZHEIMER DISEASE

New tools could improve Alzheimer disease diagnosis from structural MRI

> The model could accurately distinguish between individuals with AD and those with non-neurodegenerative conditions

Two studies, recently published in *Neuroimage: Clinical*, present new computational tools for the detection of brain atrophy from structural MRI (sMRI) data. The findings could improve the accuracy of Alzheimer disease (AD) diagnosis.

Individuals with AD show progressive brain atrophy, which can be detected with sMRI and has been used as a biomarker for early diagnosis. Automated processing techniques have been developed to segment brain regions of interest in sMRI images and measure atrophy. In the first study, Hanne Struyfs and colleagues developed a new tool to perform this segmentation. The tool, named ico**brain dm**, divides the sMRI image into white matter, grey matter and cerebrospinal fluid then identifies the hippocampi and sub-regions of cortical grey matter.

The researchers applied ico**brain dm** to data from a cohort of healthy individuals and compared its performance with that of the existing image segmentation tool FreeSurfer as well as manual segmentation by experts. When compared with manual segmentation, both automated tools underestimated the volume of several brain regions; however, ico**brain dm** was more accurate than FreeSurfer.

Struyfs and colleagues then applied ico**brain dm** and FreeSurfer to data from a cohort comprising 46 individuals with AD and 23 controls and tested the ability of the tools to predict diagnosis on the basis of the volume of individual brain regions. Both tools were highly accurate, but the most accurate predictor was temporal lobe volume measured by ico**brain dm**.

"We conclude that due to its low measurement error, ico**brain dm** could be of added value to the clinical diagnostic practice of AD patients," say the researchers in the paper. "In future studies the performance of the measures to diagnose (very) early stages of AD, as well as to distinguish between different dementia illnesses, should be further investigated."

In the second study, Lauren Koenig and colleagues used FreeSurfer to segment sMRI images, but designed a model that combined volumetric measurements from multiple brain regions to predict AD diagnosis. The researchers analysed publicly available sMRI data from a cohort of individuals with symptomatic AD and healthy controls and tested the ability of different combinations of volumetric measures to distinguish between the two groups of participants. The resulting model, named SARA, used data on brain regions including the hippocampus, inferior lateral ventricle, amygdala, and entorhinal and inferior parietal cortices to predict the diagnosis of individual participants.

SARA was tested on data from a separate cohort comprising individuals with AD and controls, and the model predicted diagnosis with a receiver operating characteristic (ROC) area under the curve (AUC) value of 0.961. The closer the ROC AUC value is to 1, the more accurate the diagnostic test. Hippocampal volume alone predicted diagnosis with a lower ROC AUC value than SARA, although the difference was not statistically significant. The researchers also adjusted SARA to take into account the trajectory of healthy age-related brain atrophy; however, this adjustment did not improve the diagnostic accuracy of the model.

Koenig and colleagues then tested the performance of SARA on data from a clinical cohort. The model could accurately distinguish between individuals with AD and those with non-neurodegenerative conditions, such as sleep disorders, and was also able to distinguish between AD and frontotemporal dementia. However, the researchers point out that this clinical cohort was too small for robust statistical analysis.

"SARA may be useful as a first step for selecting symptomatic AD participants for entrance into clinical trials or as an adjunct to the diagnostic algorithm when a clinical differential diagnosis includes AD versus frontotemporal dementia or non-neurodegenerative conditions," conclude the researchers in the paper.

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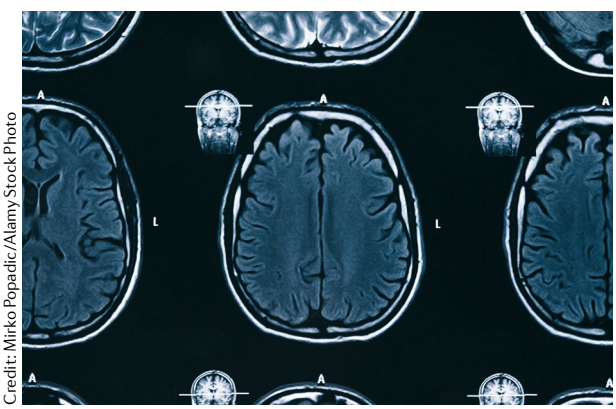

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ORIGINAL ARTICLES Struyfs, H. et al. Automated MRI volumetry as a diagnostic tool for Alzheimer's disease: validation of icobrain dm. *Neuroimage Clin.* **26**, 102243 (2020) | Koenig, L. N. et al. Select atrophied regions in Alzheimer disease (SARA): an improved volumetric model for identifying Alzheimer disease dementia. *Neuroimage Clin.* https://doi.org/10.1016/j.nicl.2020.102248 (2020)