AI can predict future brain changes in elderly patients with cognitive impairment

Preliminary study shows that a deep learning-based algorithm can forecast brain development from images obtained in FDG-PET examinations

BUDAPEST, HUNGARY, July 4, 2023 /EINPresswire.com/ -- Deep learning can accurately predict brain development up to six years after initial assessment of Alzheimer's disease on FDG-PET scans, according to a preliminary study presented at EAN 2023, the 9th Annual Congress of the European Academy of Neurology (EAN) in Budapest, Hungary.

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>
> *Elena Doering*

Researchers from Germany and Iceland have successfully used a convolutional neural network (CNN) to train an algorithm on the first two FDG-PET scans to predict the third scan acquired in elderly (>+ 55 years) participants from the Alzheimer's Disease Neuroimaging Initiative, who received FDG-PET imaging in three consecutive years.

"The algorithm accurately predicted the overall future FDG-PET signal of the entire brain, i.e., metabolic reduction, which reflects neuronal activity," said Elena Doering, a PhD student at the German Center for Neurodegenerative Diseases (DZNE) in Göttingen. "The algorithm was able to anticipate future signal decline - i.e., metabolic reduction, reflecting loss of neuronal activity."

The algorithm could even be extended to predict FDG-PET up to six years after the initial scan, by sequentially using model output as input for subsequent-year predictions.

"With our algorithm, we are currently able to accurately predict brain development up to six years after initial assessment," she said. "Predictions for a particular year were achieved by using scans from the two previous predicted years."

Furthermore, the tool appeared to detect ongoing neurodegenerative processes already at baseline, as it predicted a significant signal decline in year 2 in Alzheimer's disease (AD) patients in AD-prone regions, such as the bilateral inferior temporal and parietal regions, and the posterior cingulate cortex.

A one-of-a-kind study

The trial is exploring unknown territory, as prediction of longitudinal metabolic changes in the brain as measured by FDG-PET has barely been tested yet.

“Previous studies demonstrated that AI could be used to predict clinical symptomatic changes of neuropsychiatric disorders on the basis of baseline neuroimaging information,” the authors wrote. “However, studies that successfully predict actual longitudinal changes of the whole brain are very sparse, compared with the number of studies that observe specific longitudinal changes, such as hippocampal volume.”

Having a tool that predicts longitudinal FDG-PET scans from scans collected at baseline and one year later, could help improve patient care.

“Such an algorithm would allow physicians to read an anticipated ‘future’ FDG-PET brain scan as they would in their normal routine, but years in advance,” Doering said.

Previous studies such as IDEAS1 have shown that imaging-informed diagnoses can lead to changes in clinical management compared to diagnoses provided solely based on clinical characteristics.

As databases continue to increase and to capture longer time frames, the prediction may become available for even more extended time frames than six years, Doering believes.

“We hope that our work can provide clinical benefit in two ways: improving early diagnosis or providing reliable prognosis; and allowing individual prediction of brain pathological changes over time,” she said.

The study may also help improve understanding on the natural course of AD, whose etiology remains elusive to date.

“One of the main risk factors is age, but genetic variations and lifestyle factors, such as diet, physical exercise and years of education, also play a part in the development of the disease,” she said. “Our results could aid in the identification of factors leading to more or less rapid progression and obtain a more individualised prognosis, even without the need of repeated brain imaging examinations.”

For therapy trials, the new tool may become relevant to judge the effect of a specific drug in an individual patient, as assessed by comparison of the actual versus the predicted brain status following therapy.

“Another potential application of our algorithm could be to predict drug efficacy within clinical trials, even without the need for longer follow-up or repeated imaging examinations,” she

concluded.

Members of the press who wish to view the full presentation of the study may request press access to congress - onsite or virtual. A full copy of all abstracts from the congress is publicly available here.

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