Neurodegenerative diseases

Artificial intelligence enables early diagnosis of dementia

We are all afraid of neurodegenerative diseases such as Alzheimer's and Parkinson's disease. Yet, therapies are increasingly becoming available. Although they do not cure what causes a disease, they can at least slow down its progression, provided it is diagnosed as early as possible. The Tübingen-based start-up AIRAmed has developed software that uses artificial intelligence to measure and detect changes in the brain long before they become apparent to doctors.

Dementias with their special forms of Alzheimer's disease, multiple sclerosis and Parkinson's disease - all of which are neurodegenerative diseases caused by the death of nerve cells in the brain - are widespread: dementia currently affects around 65 million people worldwide, and it is estimated that a new sufferer emerges every three seconds.[1] Therapies that cure such diseases are still virtually non-existent. However, it is possible to significantly delay the progression of the disease through individual treatments. But only if the disease is diagnosed very early.

With the help of artificial intelligence, individual changes in brain volume can be detected within a few minutes and therapy for neurodegenerative diseases can be initiated quickly.
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Currently, the most common method of diagnosing these diseases, in addition to neuropsychological tests and examination of the cerebrospinal fluid, is examining brain volume using MRI (magnetic resonance imaging). While a decrease in brain volume is completely normal as we age and amounts to about two percent annually for everyone over the age of 50, a much greater decrease is a clear marker of neurodegenerative disease.

What sounds clear and unambiguous to the layperson, however, is not clear at all in practice: the interpretation of the images is very much dependent on the trained eye of a physician. And notwithstanding the physician's skill, there is a great deal of leeway in the purely visual interpretation of radiological image data. However, as far as neurodegenerative diseases are concerned, it is particularly important to detect even the smallest changes in brain volume in order to be able to make a diagnosis as early as possible. This is very difficult with the naked eye and therefore it's usually only possible to make a reliable diagnosis at an advanced stage - often too late for therapy that delays the progression of the disease.

Measurability of findings as a major advantage

It's high time that we had some objective measurements, Dr. Tobias Lindig and PD Dr. Benjamin Bender, two senior physicians from the Department of Diagnostic and Interventional Neuroradiology at Tübingen University Hospital thought some years ago. They began developing a software using artificial intelligence (AI). They were successful: their software solution AIRAscore structure now provides a tool to measure brain volume and changes in it. The software is based on neural networks that capture MRI data of the head accurately and rapidly. The resulting objective, very concrete measured values are then compared with a large pool of reference data. This makes it possible to check whether individual values for the respective gender and age are normal or whether they deviate from the norm and are thus disease indicators.

To ensure that their innovative medical product reaches patients as quickly as possible, the two physicians joined forces with business economist Christiane Lindig in 2019 to found the start-up AIRAmed GmbH, which translates findings from academic research into AI software. "Radiological diagnosis up until now has differed strikingly from other medical disciplines in one thing - and that is objective measurability," explains Christiane Lindig, head of corporate development. "For a long time, the

technology to process large amounts of 3D data was not yet ready. However, for some time now, new graphics cards have made it possible. So, with the help of a large amount of our own and external data, we are able to train neural networks to provide reliable and objective measurement values."

Analysis takes less than five minutes

The image data is sent for analysis in pseudonymised form directly from the MRI scanner of a radiology practice or clinic to the Tübingen-based start-up's servers, where it is processed with the help of AI. The resulting measured values of the various brain regions are returned to the physician within minutes as an evaluation report - very similar to laboratory findings. In the event of deviations from the norm, the physician can then immediately discuss the next steps with the patient on site and initiate important therapies without delay. It is also possible to monitor and check the progress of the chosen medication on a regular basis to identify promptly whether the patient is responding to therapy - or whether medication needs to be adjusted immediately.

The treating physician receives the measured values of the MRI image analyses in a form similar to laboratory findings and can discuss them with the patient on site.
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"We explicitly do not make a diagnosis, but instead offer the diagnosing physician - usually a radiologist, neurologist or psychiatrist - important support through objective measured values," says Lindig. "The software detects everything that impacts on brain volume, so diseases such as dementia, Parkinson's, multiple sclerosis or even many rare neurodegenerative diseases can be detected at a very early stage." However, the examination is not covered by health insurance. "But the cost is affordable in most cases if the MRI scans are done with a doctor's referral," Lindig said.

Even though there is still no causal therapy available for most neurodegenerative diseases, enormous progress has been made over the past 15 years. A few weeks ago, a new Alzheimer's drug was approved in the USA for the first time in 18 years. A number of effective drugs that can delay the course of the disease are also available for Parkinson's and multiple sclerosis sufferers, if they are prescribed at an early stage. "For some patients, however, it's simply a relief to know what they're dealing with," says Lindig.

Data is the be-all and end-all

AIRAmed stands for 'Artificial Intelligence in Radiology'. With its team of 16 employees, the young company is considered an expert in the field of quantitative neuroradiology. The company works cooperatively in research and development with Tübingen University Hospital, and also with other institutions, including the Max Planck Institute for Biological Cybernetics and other Cyber Valley institutions. "Our main need is pseudonymised health data," says the founder. "Because data is the be-all and end-all for developing innovative AI solutions. Any AI is only as good as the data it is based on."

In the coming weeks and months, the Tübingen-based AI specialists will be entering the market. "Some pilot practices and clinics are already using our software, and broad distribution is now underway," reports Lindig. "Certification as a CE-marked medical product took a lot of time. Now we are in concrete talks with investors and potential sales partners. And, of course, we are also working on the continuous improvement of our software solution and the expansion of the product range. The market for quantitative radiology is just emerging internationally, but we are confident that the accuracy of our products in combination with AIRAmed's service and service consciousness will prove convincing in the long run."

References
1) Alzheimer's Disease International (2018): World Alzheimer Report 2018, The state of the art of dementia research, New frontiers, London

Article

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