Nanotechnology Could Enable Test for Early Alzheimer's Disease

2021-03-23
University of Manchester scientists have discovered previously unseen blood biomarkers which could one day be used to test for Alzheimer's disease, years before its symptoms appear.

The ground-breaking study, published in [ACS Nano](#), used cutting-edge nanotechnology uniquely developed and patented by the Nanomedicine Lab in Manchester, to extract blood signals of neurodegeneration in a mouse model of Alzheimer's disease. The study was funded by the Medical Research Council.

Tests that capture early signs of neurodegeneration in blood offer enormous potential for Alzheimer's disease and other dementia patients to receive effective treatment or manage effectively their progressive condition before significant brain damage occurs.

Today, Alzheimer's disease can be diagnosed by imaging techniques - brain scans - and is only possible after someone has been showing behavioural symptoms, such as memory impairment.

By the time symptoms emerge however, the pathology is already well-established in the brain - when it is often too late to treat patients effectively.

Though early markers of Alzheimer's disease are believed to be present in blood, their minute levels make it extremely difficult to detect them - like looking for a needle in a haystack.

But thanks to the technology developed by the Manchester team, low blood signals that

could non-invasively describe the onset of Alzheimer's disease can now be magnified and analysed.

Dr Marilena Hadjidemetriou, the lead researcher of the study and Lecturer in Nano-omics said: "Hidden information in blood is likely to echo the complex cascade of events occurring in the brain of Alzheimer's disease patients.

"We wanted to engineer a nanotechnology blood-mining platform in order to uncover this information and identify early signs of Alzheimer's disease at the pre-disease state - before the onset of amyloid plaque formation in the brain.''

Amyloid plaques are clumps of protein fragments which are toxic to nerve cells.

The team employed nanotechnology in order to enhance the sensitivity of mass spectrometry, a proteomic technique used to analyse the patterns of proteins in blood.

They used tiny nano-sized spheres, called liposomes, as a tool to 'fish out' disease specific proteins from blood.

When injected in mice with Alzheimer's Disease, nanoparticles spontaneously picked up hundreds of neurodegeneration-associated proteins onto their surfaces.

The nanoparticles were then retrieved intact from blood circulation and the molecular signatures on their surface were analysed.

Professor Kostas Kostarelos, Professor of Nanomedicine said: "This study was rather like a fishing expedition: we didn't know what was beneath the surface of the ocean.

''The nano-tool we developed allowed us to see deeper into the blood proteome, identifying

proteins of interest that are directly associated with neurodegeneration processes in the brain, among thousands of other blood-circulating molecules.

"We hope that these early warning signs of Alzheimer's disease could one day be developed into a blood test and we are actively seeking validation of these signatures in human blood.''

It was only by tracking the protein levels at different stages of Alzheimer's disease that the team were able to identify complex disease-monitoring patterns.

Dr Catherine B. Lawrence, Senior Lecturer at the Division of Neuroscience and Experimental Psychology said: "We were extremely interested in the fluctuation of protein levels at different disease stages - from the pre-diseased state, to the intermediate state between amyloidopathy and cognitive symptoms and finally symptomatic disease.

"These findings indicate that single-time point blood biomarker discovery studies provide only a snapshot of the blood proteome.

''This could explain previously reported inconsistent results and the lack of clinically-used blood-based biomarkers for Alzheimer's disease.''

Professor Nigel Hooper, Associate Vice-President for Research and Director of Dementia Research at [The University of Manchester](#) said: "The technology developed opens up new possibilities for the development of novel multi-analyte blood tests to predict the onset and development of a wide range of neurodegenerative disorders."

Read the [original article](#) on The University of Manchester.