Zero-Field MRI to Enhance Diagnosis of Neurodegeneration

https://neurodegenerationresearch.eu/survey/zero-field-mri-to-enhance-diagnosis-of-neurodegeneration/

Principal Investigators

Lurie, Professor DJ

Institution

University of Aberdeen

Contact information of lead PI
Country

United Kingdom

Title of project or programme

Zero-Field MRI to Enhance Diagnosis of Neurodegeneration

Source of funding information

EPSRC

Total sum awarded (Euro)

€ 1,327,563

Start date of award

01/02/2013

Total duration of award in years

3.9

The project/programme is most relevant to:

Alzheimer's disease & other dementias

Keywords

Parkinson's disease and PD-related disorders|Neurodegenerative disease in general

Research Abstract
Neurodegenerative diseases present major public health concerns, with over 0.85m cases in the UK (expected to double by 2040 due to an ageing population) at an annual cost to the economy of >£23bn. There is an urgent need for neuroprotective agents that could be used

early to slow disease progression, but none currently exist. The major barrier is the difficulty of early diagnosis (when agents are most likely to be effective) and the lack of robust biomarkers (to measure drug efficacy). Thus the prospect of non-invasive early diagnosis and therapy monitoring using new medical imaging technologies is compelling.

In this project we plan to develop a radically new diagnostic imaging method, called Zero-Field (ZF) MRI. Due to its ability to use interactions that are completely masked at the high magnetic fields used by normal MRI scanners, ZF-MRI should have exquisite sensitivity to molecular changes in brain tissue, bringing the possibility of early diagnosis. The challenge is to develop imaging technology that will enable pre-symptomatic diagnosis of neurodegenerative diseases associated with abnormal protein aggregation, particularly Alzheimer's and Parkinson's diseases.

In our recent research we have developed technology and methods of a new type of MRI called Fast Field-Cycling MRI (FFC-MRI). In this technique (which requires very special magnets, power supplies and control electronics) the magnetic field is switched rapidly between levels, always returning to the same field for signal detection. In ZF-MRI the magnetic field will be held at zero for part of the procedure, during which time the special zero-field interactions will take place. In this manner, the resulting images of the brain will contain information about brain structure and function at the molecular and cellular levels, which has hitherto been invisible to MRI.

Work will be carried out using an existing human-sized FFC-MRI scanner that we have built in our laboratories. In order to employ it fr ZF-MRI we will devise methods to cancel the Earth's field within the volume of the scanner, using cancellation coils along with the scanner's shim coils. New techniques will be developed to measure and minimise the residual magnetic field. Several magnetic resonance phenomena are known to exist at zero field and we will develop methods to exploit them for enhanced diagnosis. They include, for example, the tiny magnetic fields generated by atoms within protein molecules. These magnetic fields are insignificant compared to the very strong magnetic fields used in conventional hospital MRI scanners. However, by operating at zero magnetic field (for part of the scanning procedure) ZF-MRI will be exceptionally sensitive to changes in these magnetic fields, and hence to the tissue structure and content.

Tests of ZF-MRI will be carried out using tissue-mimicking test samples made of gels and other chemicals, then protein aggregates of the kind we expect to encounter in patients' brains, followed by pre-clinical studies. This will allow us to determine the sensitivity of ZF-MRI to subtle changes in tissue composition and molecular dynamics. Later in the project we will scan patients (subject to ethical approval) who are known to have neurodegenerative conditions, together with normal volunteers, and will compare the results obtained from ZF-MRI with brain scans obtained on our 3-tesla conventional MRI scanner.

Lay Summary
Further information available at:

Types:
Investments > €500k

Member States:
United Kingdom

Diseases:
Alzheimer's disease & other dementias

Years:
2016

Database Categories:
N/A

Database Tags:
N/A