Research sheds new light on epilepsy

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Pioneering research using human brain tissue removed from people suffering from epilepsy has opened the door to new treatments for the disease.

Scientists at Newcastle University have for the first time been able to record spontaneous epileptic activity in brain tissue that has been removed from patients undergoing neurosurgery.

Led by Newcastle University's Dr Mark Cunningham, the research has revealed that a particular type of brain wave pattern associated with epilepsy is caused by electrical connections between nerve cells in the brain - rather than chemical ones. This means the traditional drugs are useless to them.

Published today in the Proceedings of the National Academy of Sciences (*PNAS*), Dr Cunningham said the findings marked a huge step forward in our understanding of a disease which affects an estimated 45 million people worldwide.

"Until now we have only been able to mimic epilepsy using experimental animal models but this can never give you a true picture of what is actually going on inside the human brain in epilepsy," explained Dr Cunningham who is based in Newcastle University's Institute of Neuroscience.

"Our findings help us to understand what is going wrong and are an important step towards finding new epilepsy treatments in the future."

The first line of treatment for patients with epilepsy uses anti-epileptic drugs to control seizures.

However, in almost 30 per cent of patients the drugs don't work. In this case, one course of action available to them is a neurosurgical procedure in which the brain tissue responsible for the epilepsy is removed from the patient.

Working in collaboration with the Epilepsy Surgery Group at Newcastle General Hospital and IBM Watson Research Centre in New York, the team - with permission from the patients - have taken this epileptic tissue into the lab and 'fooled' it into thinking it is still part of the living brain.

They have then been able to record electrical signals from individual neurons and also networks of neurons.

Comparing this with normal brain tissue activity they managed to record an underlying 'noise' - a particular type of brain wave, or oscillation, which occurs in the intact epileptic human brain and which scientists believe is a precursor to an epileptic seizure.

Using a combination of experimental techniques, the team have shown that rather than being controlled by chemical signals which most conventional anti-epileptic drugs target, this oscillation relies on direct electrical connections.

"This may explain why the traditional drugs that target chemical connections don't work for patients with this kind of epilepsy," explains Dr Cunningham, who conducted the research with his colleague Professor Miles Whittington.

"These findings have massively increased our understanding of epilepsy

and offer real hope in terms of finding new ways of tackling the disease.

"The next step is to understand what it is that triggers the transition between the underlying epileptic state of the brain cells and the fast oscillations that are responsible for causing a seizure."

Source: Newcastle University