Prediction and Diagnosis of Seizures and Other Neurological Events (Case 2045)

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Technology description

Brief Description:
Seizures and epilepsy, paroxysms of neuronal activity, have been recognized for centuries, yet little is understood about the etiology, mechanism and time course from pre-onset through episodic onset and the usual abrupt and spontaneous end. The breakdown in single and clustered neuronal activity remains unclear. Diagnosis is largely based on electroencephalogram (EEG) recordings that reflect the averaged activity of millions of neurons. Neuronal activity patterns in ensembles of single neurons during epileptic seizures show a wide variety of behaviors during seizure initiation and maintenance, becoming active at different times during seizure propagation, and exhibiting distinct patterns with transient increases or decreases in spiking rates. Few human studies have gone beyond macroscopic scalp and intracranial EEG signals to examine the underlying neuronal spiking, or single-neuron action potential activity, and studies that have, recorded mostly from the amygdala and hippocampal formation - not the neocortex. Hence, the behavior of single neurons and the collective dynamics of neuronal networks in human epilepsy remain largely unknown; reliable predictive data based on pre-seizure neuronal activity recordings is elusive. Therefore, more information is needed to predict, diagnose, and effectively monitor and control diseases/disorders based on neuronal dysfunction. The invention is a new method for prediction and early detection of neurological events, such as epileptic seizures, by recording continuous signals from single neurons, and measuring and characterizing coordinated spiking activity of such in a neuronal pathway, to elucidate patterns of collective neuronal dynamics at the cortical level. Thus, this novel system directly addresses the limitations of existing approaches. Mathematical algorithms with computing software to analyze recorded information are a part of this invention. This invention has fundamental implications for use with neurological and psychiatric diseases and disorders, in cognitive and adaptive behavior studies, and for development of intracortical neuronal interfaces for next generation motor prostheses.
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Application area

Within the diagnostics market, applications are many and across medical specialties. The invention can indicate disordered, diseased or injured states to predict and diagnose not only epileptic seizures, but also a myriad of psychological, neurological and medical conditions.Some applications include: determining severity of metabolic encephalopathy in critical medical illness, including liver failure; detecting neuronal or cortical dysfunction resulting from many pathological or medical scenarios such as ischemia/neural oligemia, traumatic brain injury, incipient ischemia in cerebral vasospasm following subarachnoid hemorrhage, resolution of status epilepticus as determined during the treatment and emergence from pharmacology-induced burst-suppression behavior, and monitoring efficacy on the cellular level of pharmacotherapeutics for personalized medicine or drug development.

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