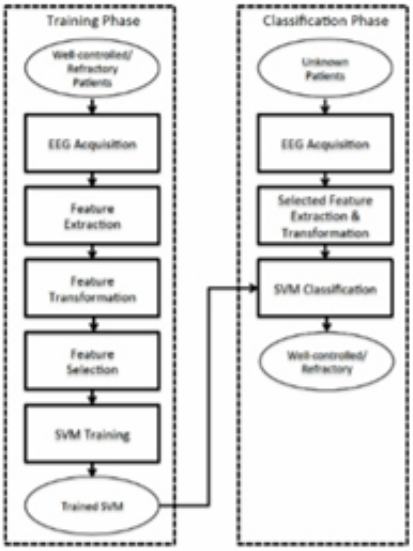
Breakthrough in detecting early onset of refractory epilepsy in children

September 15 2014



Flowchart of approach

65 million people around the world today suffer from epilepsy, a condition of the brain that may trigger an uncontrollable seizure at any time, often for no known reason. A seizure is a disruption of the electrical communication between neurons, and someone is said to have epilepsy if they experience two or more unprovoked seizures separated by at least 24 hours.

Epilepsy is the most common chronic disease in pediatric neurology, with about 0.5–1% of children developing epilepsy during their lifetime.

A further 30–40% of epileptic children develop refractory epilepsy, a particular type of epilepsy that cannot be managed by antiepileptic drugs (AED). Regardless of etiology, children with refractory epilepsy are invariably exposed to a variety of physical, psychological and social morbidities. Patients whose seizures are difficult to control could benefit from non-pharmacological therapies, including surgery, deep brain stimulation and ketogenic diets. Therefore, the early identification of patients whose seizures are refractory to AED would allow them to receive alternative therapies at an appropriate time.

Despite idiopathic etiology being a significant predictor of a lower risk of refractory epilepsy, a subset of patients with idiopathic epilepsy might still be refractory to medical treatment.

Using a new electroencephalography (EEG) analytical method, a team of medical doctors and scientists in Taiwan has successfully developed a tool to detect certain EEG features often present in children with idiopathic epilepsy.

The team developed an efficient, automated and quantitative approach towards the early prediction of refractory idiopathic epilepsy based on EEG classification analysis. EEG analysis is widely employed to investigate brain disorders and to study brain electrical activity. In the study, a set of artifact-free EEG segments was acquired from the EEG recordings of patients belonging to two classes of epilepsy: well-controlled and refractory. To search for significantly discriminative EEG features and to reduce computational costs, a statistical approach involving global parametric features was adopted across EEG channels as well as over time. A gain ratio-based feature selection was then performed.

The study found a significantly higher DecorrTime avg AVG and RelPowDelta avg AVG in the well-controlled group than in the

refractory group. This suggests that refractory patients have a higher risk of seizure attacks than well-controlled patients.

The main contributions of this study are as follows:

1. the generalisation of 10 significant EEG features into a concept for the recognition and identification of potential refractory epilepsy in patients with idiopathic epilepsy, based on EEG classification analysis;
2. the development of a diagnostic tool based conceptually on these 10 EEG features, using a support vector machine (SVM) classification model to discriminate between well-controlled idiopathic epilepsy and refractory idiopathic epilepsy, which will facilitate subsequent expert visual EEG interpretation.

Further research with more diversity (in terms of pediatric and adult participants) is encouraged to expand on the tool's reliability and generalisation. This study was supported partly by a grant from the Kaohsiung Medical University Hospital and grants from Ministry of Science and Technology, Taiwan.

More information: To read the full paper and for further details, please visit www.worldscientific.com/doi/pd … 42/S0129065714500233 . The paper can be found in the upcoming issue of the *International Journal of Neural Systems* (*IJNS*).