Master track Medical Sensing and Stimulation

Predicting epileptic seizures with use of EDA, HRV, temperature and SpO2

Group 1; Koen van der Sluijs, Vincent Wolbert, Ruben Dollen, Vivianne de With

Abstract:
It would be very helpful for patients who suffer from epilepsy if seizures were predictable. In this way they might be able to perform all day activities again, like driving, without the danger of an unexpected seizure. In literature many possible ways of predicting seizures are evaluated, but none seems successful so far. This case study is about the predicting value of a combination of four parameters: electrodermal activity, heart rate, arterial oxygen saturation and skin temperature. These four parameters combined proved to be able to predict migraine attacks and might therefore be valuable for predicting epileptic seizures as well.
For measuring these parameters an E4 wearable wristband designed by Empathica and a pulse oximeter were used. The usability and reliability of the E4 were evaluated as well as a comparison between a patient suffering from epilepsy and healthy controls.
A significant difference between these groups or predicting value have not been found during this study. But the potential and suggestions for a follow up study are discussed.

Localisation of the Near-Infrared spectroscopy sensor for seizure prediction

Group 2; Anouk Scholten, Kim Wijlens, Anne- Jet Jansen, Mitchel van der Waard

Abstract:
The aim is to measure the penetration depth of Near-Infrared Spectroscopy sensors by stimulating different cortexes, considering possible future seizure detection in epileptic patients.
Healthy subjects are included undergoing different exercises with Near-Infrared Spectroscopy sensors on their forehead.
A larger increase of oxyhemoglobin is measured in more frontal lobes.
It was not possible to include an epileptic patient. The amount of focus and accuracy of the measurement varies between healthy subjects. Noise and artefacts influence the results.
The stimulation of the prefrontal cortex can be measured with NIRS. No conclusion can be drawn from stimulating cortex further away due to focus and thereby also activating the prefrontal cortex.

Prediction of epileptic attacks in epileptic patients using parasympathetic parameters

Groep3; Jantine Smit, Elin Biel, Lyan Vlaskamp, Gerike Buitenhuis

Abstract:

Introduction: Due to the unpredictability of seizures, epileptic patients often live in great uncertainty. This research focuses on deriving a method to predict the occurrence of an epileptic seizure by investi-gating the parasympathetic tone. The following parameters are measured: heart rate, HR variability, respiratory rate and peak expiratory pressure.
Method The mentioned variables will be measured using the eMotion Faros 90◦ and a pressure sensor with nose cannula. The data was analyzed using Matlab 2016a.
Results Compared to the eight control subjects, the HR of the patient is increased, the HRV is de-creased and the peak expiratory pressure was decreased. No notable differences in the RR were found when comparing the patients' data with the control group.
Discussion The patient population consisted of only one subject (n=1), which had a very different lifestyle from the control group. In addition, the pressure sensor was very inaccurate and unstable.
Conclusion Opposed to the initial expectations, the parasympathetic tone seemed to be decreased in the patient, instead of increased.

Predicting epileptic seizures by using a combination of high frequency oscillations, heart rate variability and electrodermal activity

Group 4; Simone van Nuil, Elisa Verhoeven, Lisa Rutten, Marloes Verhulst

Introduction: Epilepsy can cause a decrease in the quality of life.
Aim: The combination of electrodermal activity (EDA), heart rate variability (HRV) and high frequency oscillations (HFOs) was investigated to predict seizures.
Method: Encephalography and an E4-wristband were used to measure the parameters for one patient and a control group during rest and activity.
Results: HFOs and differences in HRV between both groups were not found. EDA showed an equally small increase during activity and rest.
Conclusion: The population was too small for reliable conclusions so more research is needed to determine if this combination could be a good predictor for seizures.

Can HFOs in scalp EEG and eyeblinks be used as a predictive tool in epilepsy patients?

Group 5; Nick Eleveld, Maud Hoofs, Laura Treurniet, Thomas Urgert

ABSTRACT:
Over the past years, it has been discovered that High Frequency Oscillations(HFOs) may be an important parameter for clinical evaluation of epilepsy patients. Besides their high spatial correlation with the seizure onset zone, they might also show a temporal correlation with epileptic activity. However, HFOs are currently only detected in intracranial EEG, making usage as a general diagnostic and predictive tool not feasible. This study aims to detect HFOs in scalp EEG recordings.

Epilepsy and eye blinks show various correlations in previous literature. This research focuses on the correlation between eye blinks and HFOs, to determine the usability of eye blinks as a predictive tool.

Using infrared light to predict epileptic seizures

Group 6; Erik- Jan Meulenbrugge, Esther Lems, Bas Meuter, Janna Ruisch

Abstract:
Using infrared light to predict epileptic seizures
Many studies have been conducted for finding a method to predict epileptic seizures, for improving the quality of life from patients with epilepsy. Some studies showed a change in oxygenation of the brain before the seizure onset. The purpose of this study is to investigate the differences of the oxygenation in the brain, using near-infrared spectrometry (NIRS), with the oxygenation somewhere else in the body, using a pulse oximeter. Both a patient with focal epilepsy, located in the frontal cortex, and four healthy subjects were measured. Three different measurements have taken place, measuring the subject at rest, in mental effort and in physical effort. These three tests are being compared.

Prediction of epileptic seizures through stress measurements using salivary cortisol and HRV

Group 7; Thijs Nassi, Lieke Numan, Raymond van Wijk, Marijn Mulder

Abstract:
Long term prediction of epileptic seizures would be beneficial in daily life of patients. Since they report stress most often as the cause of seizures, further investigation might contribute to their quality of life. The relation between seizures and stress is studied by performing heart rate variability (HRV) analysis and salivary cortisol measurements in one patient and two controls. The patients salivary cortisol concentration is found to be lower than controls, which was not expected. However, the pNN50 parameter acquired from HRV could be used to distinguish between patient and controls. This exploratory study suggests further investigation of HRV and cortisol as long-term seizure predictors within a larger population involving seizures during observation.

Power spectral density ratios and heart rate variability combined in an algorithm for long term seizure prediction in epilepsy patients

Group 8; Nynke Wijbenga, Silvano Gefferie, Loes Zaremba, Job de Haan

Abstract:
In current practice, long term seizure prediction in epilepsy patients remains a thorny issue since these seizures cannot accurately be predicted. However, several studies show a correlation between specific spectral bands ratios and an upcoming seizure. Further correlation has been found between upcoming seizures and heart rate variability. We therefore present an algorithm that combines both predictors for short term notification of the user. The goal is eventually improving the algorithm for long term seizure prediction. To accomplish this goal, a minimization of the amount of used electrodes has been investigated, for future patient convenience.

Long-term prediction of epileptic seizures based on peripheral excitability measured with EMG

Group 9; Mireille Kamminga, Ditte Moejes, Cindy Rikhof, Rob Warnaar

Abstract:
Epileptic patients suffer from unpredictable, recurrent seizures. The purpose of this study was to find a long-term predictor of epileptic seizures. Peripheral excitability was investigated as potential predictor. Stimulus-response curves were obtained with EMG from which rheobase and chronaxie were determined. The hypothesis was that patients experiencing seizures had decreased peripheral excitability compared to a healthy control group. This was tested by comparing EMG results to a questionnaire about seizure occurrence. Eight healthy subjects were included. The results showed rheobase values of 1.85 ± 0.41 mA and chronaxie values of 0.326 ± 0.11 ms in the control group, which are comparable to literature. No measurements in epileptic patients were performed. These are required in the future to test the hypothesis.

Changes in HRV and EDA during daily activities for epileptic patients and healthy subjects contributing to epileptic seizure prediction

Group 10; Marthe Huntelaar, Athra Malki, Maartje Dekker

Abstract:
The electrodermal activity (EDA) and the heart rate variability (HRV) are promising detection parameters for seizure onset in epileptic patients. During epileptic seizures activity is seen in brain structures related to the autonomic nervous system. Sympathetic activation influences both the EDA and HRV. Daily activities also contribute to a change in sympathetic activation. The goal is to get insight in these influences for epileptic patients and healthy individuals by measuring via a wearable device. At the end these daily activities should not lead to a detection alarm for seizure onset. It turns out that the EDA increases for daily activities. For the HRV there is no unambiguous result.