Master track Medical Sensing and Stimulation

Patient-control study for diagnosing primary Restless Leg Syndrome using electroencephalography

Group 1; Paulien Engelbert, Bas Peters, Laurien te Nijenhuis, Annemarie Smid

Abstract:
One out of twenty people suffer from Restless Leg Syndrome (RLS), which can result in a lack of sleep. However, RLS is often misdiagnosed. The goal of this research is to develop a method to improve the diagnostics for primary RLS. Three healthy persons filled in the RLS rating scale and underwent a 20-leads EEG. After filtering the EEG data, the total power and absolute and relative powers at different frequency bands are calculated and visualised in a grid. Due to the lack of patient measurements, this study was only used to optimise the research method and create a good analysis tool for further research with RLS patients. For healthy patients a visualisation was made and could be compared to the RLS rating scale. However, the little literature available limited the research. The proposed method to diagnose primary RLS objectively with EEG cannot be deemed successful as of yet. However future measurements could prove the effectiveness of this method compared to the current golden standard.

Keywords: Restless Leg Syndrome, primary RLS, Electroencephalography, EEG, alpha frequency band, RLS rating scale

Distinction between different sleep stages by means of analysing the oxygen saturation with Near Infrared Spectroscopy and an accelerometer

Group 2; Meike van Sleuwen, Diantha Schipaanboord, Maud Schreijer, Lianne Tolboom

Abstract:
Current methods to diagnose sleeping disorders have significant disadvantages. These disadvantages make it desirable to find a new method to diagnose sleeping disorders. The most important demand for this new method, is that it can be performed while the patient sleeps in his own home. Sleep is divided in nonrapid eye movement sleep and rapid eye movement sleep. Sleeping disorders manifest itself in a certain sleep stage, which makes it possible to distinguish between sleeping disorders when a distinction between these two sleep stages can be made. The rapid eye movement sleep stage is characterised by more movement and this causes the oxygen saturation and heart rate to rise. Oxygen saturation can be measured with near-infrared spectroscopy and heart rate can be measured with an accelerometer. The goal of this research is to verify if Near-Infrared Spectroscopy (NIRS) and an accelerometer can be used to classify nonrapid eye movement and rapid eye movement sleep stages.
NIRS and an accelerometer are used to measure the oxygen saturation and the heart rate respectively, during the night, when the patient is asleep. In Matlab, multiple templates are selected in which movement is present. The presence of movement can be seen in the acceleration data when this data shows peaks. Two additional templates of the same length as the original template, just before and after the movement peak, are also selected. During these three templates, the mean oxygen saturation and the mean heart rate are determined. The mean saturation and mean heart rate are compared over the three templates.
The expectation is that during the movement templates, the oxygen saturation and the heart rate are higher than in the templates just before and after the movement templates. An important point to consider is that there is a compensation mechanism, which causes the oxygen saturation to decrease during periods of more movement. It is unknown how fast this compensation mechanism takes place.
For the three complete measurements in this research, the main saturation was not the same. However, the data is still under investigation and the final results are not yet obtained. The final results will be presented on the 6th of July 2018 at te University of Twente.

To what extent are surface electromyography of the submentalis muscle region and oxygen saturation measurement during swallowing able to investigate the degree of swallowing?

Groep3; Eva Kleinveld, Ilse Willemse, Lotte Stam, Marieke Reincke

Abstract:
Introduction Obstructive Sleep Apnea is a disorder which is present among the general population, the risk increases with age. It is associated with mortality and morbidity due to cerebro- and cardiovascular complications. Currently obstructive sleep apnea is diagnosed with polysomnography, which is expensive, labour intensive and uncomfortable for patients. In this research, surface electromyography and oxygen saturation are used to examine the degree of swallowing. Earlier research showed a correlation between the degree of swallowing and obstructive sleep apnea, so this could be a new diagnostic tool for obstructive sleep apnea.
Method Fourteen healthy subjects participated. One subject is excluded based on the outcomes of theEpworth Sleepiness Scale and the Snores Outcomes Survey. The activity of the area of the m. Submentalis is measured with surface electromyography. An electroencephalography amplifier is used to amplify the signals. During one measurement, six swallowing movements are performed, three with and three without a water bolus. Data is analyzed in MATLAB.
Results The results show that there is a difference in surface electromyography data between swallowing water bolus and only saliva.
Conclusion Further research with a bigger and more varied population, nasal airflow measurement and reliable EMG measurements has to be done to make a valid conclusion whether this method is usable for determining degree of swallowing. To correlate the degree of swallowing with obstructive sleep apnea, even more research should be done.

Synchronized measurement of EEG and EMG during REM sleep to replace part of the polysomnography

Group 4; Sijm Noteboom, Jeroen van Haaren, Sanne Feiner, Erik Golbach

Abstract:
Sleep can be divided in non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. During REM sleep, most of the dreaming occurs without expression of physical activity. In patients with REM sleep behaviour disorder (RBD), pathological muscle activity is present during REM sleep. Diagnosis of RBD can have a major impact on a patient's life. The golden standard diagnostic tool currently includes an extensive polysomnography with synchronized video and audio recordings. The aim of this research is to simplify this golden standard, making the measurement less unpleasant for the patient.
This is done by simultaneously measuring EEG and EMG on the chin and jaw region. Followed by relating muscle atonia during REM sleep to a healthy subject and muscle activity to a pathology, possibly RBD. Four healthy subjects were measured during sleep. Data was collected and stored with the DIPHA-system and analyzed using Matlab.
Results show that it is difficult to recognize different sleep stages in the acquired data. Recognition of NREM and REM sleep with the derivations Fp1-A1 and Fp2-A2 proved to be not accurate enough to use as a diagnostic tool.
In conclusion, the DIPHA-system proved to be able to execute synchronized measurements of the EEG and EMG simultaneously. However, the staging of REM sleep is not accurately possible. Thereby the aim of the study to simplify the golden standard with polysomnography is not yet achieved. Some recommendations are made to improve further research on this topic.

Change in infraslow activity, a measurement of cortical excitability with electroencephalography in patients with epilepsy

Group 5; Marjolein Klop, Maritta van Stigt, Jozine van Welij, Deborah Zagers

Abstract:
To determine the optimal dose of anti-epileptic drugs, an easy test should become available to measure the cortical excitability. Currently, research focuses on Transcranial Magnetic Stimulation, which is a more expensive, complicated and frightening procedure than a conventional EEG. There are indications that infraslow activity and cortical excitability cohere and that excitability increases during the time awake. This is why this research determines the infraslow activity in the morning and in the afternoon in healthy subjects, to determine if infraslow activity can be used as a surrogate for the excitability. Both the percentage infraslow activity present in the EEG recording and the power of the EEG in the infraslow frequency range are determined in four subjects. Both parameters did not change significantly in all subjects. It is uncertain if this means that there is indeed no significant correlation between the excitability and the presence and power of the infraslow activity or that the study design was not appropriate to assess this correlation.

Keywords: infraslow activity, anti-epileptics, transcranial magnetic stimulation, cortical excitability, EEG

Epileptic seizure prediction using a deep learning model for EEG data

Group 6; Sifra Blok, Silvana Riphagen, Olivier Paalvast, Douwe van der Steen

Abstract:
Epilepsy is estimated to affect approximately 50 million people worldwide About 30 percent of patients with epilepsy cannot be treated either by medication nor by surgery. If seizures cannot be controlled, the patient experiences major limitations in family, social, educational and vocational activities. These limitations severely affect the quality of life of the patient. The ability to predict epileptic seizures prior to their occurrences would improve upon a patients well being and allow them greater freedom in their daily activities. This study focussed on the possibilities of predicting a seizure based on EEG measurements. To do so, a deep learning model has been created which has been trained on a epilepsy dataset to recognise preictal seizure periods in the EEG.

Measurement of EMG during REM-sleep as a diagnostic method for narcolepsy

Group 7; Thijs Schreijer, Arjen Pelgröm, Jasper Toebes, Ruben Smink

Abstract:
Worldwide 25-50 per 100.000 people suffer from narcolepsy with cataplexy. The diagnosis is very difficult and takes a lot of time because it is often overlooked. Narcolepsy is a chronic neurologic disorder resulting from dysregulation of the sleep-wake cycle. In most cases this disorder has an early age of onset, but has a long delay until the actual diagnosis. The exact cause of narcolepsy is still unknown. The majority of cases of narcolepsy occur spontaneously. For the diagnosis there is still no golden standard, because of the overlapping symptoms with other diseases. A quicker diagnoses could be if is looked at the EMG activity during REM sleep.
EEG is used to see whether a subject is in REM sleep in combination with EMG to measure the muscle activity. In this study, data of two 22 year old, healthy male subjects was used. One of these is excluded because of a recording failure. The EMG signal is quantified by using the modified phasic electromyographic metric (mPEM) method. In contradiction with the literature the EMG electrodes in this study were placed on the jaw instead of the chin. Also the dataset in this study is very limited, because there were no actual patients available and also our control group is limited to one. Therefore there is no comparison possible between the controls and the patients. No valuable comparison could be made between healthy individuals and patients with narcolepsy. This method could prove to be valuable to diagnose narcolepsy.

Diagnosis of REM-sleep behaviour disorder (RBD) using electroencephalography (EEG) and accelerometry

Group 8; Stanley Pham, Sven Stuiver, Bram Knipscheer, Nienke Langerak

Abstract:
Objective To determine whether electroencephalography (EEG) and accelerometry can be of use to diagnose REM sleep disorder behaviour (RBD).
Background RBD is a long term predictor of neurodegenerative disorders and is currently diagnosed with polysomnography (PSG). This is a demanding study which involves many levels of interpretation and an overnight stay in the hospital. Studies have shown that EEG differences in alpha power and the dominant occipital frequency (DOF) occur between healthy subjects and RBD patients during wakefulness.
Methods Four healthy subjects were studied. Electrical activity of the brain during the awake state was recorded for 16 minutes. For three consecutive nights the movements during sleep were recorded with an accelerometer. A model was designed to determine if movement did occur during REM sleep.
Results The mean alpha power of the frontal and central leads of the EEG are determined between 1:92_0:815. Also the dominant occipital frequency lies between 12:03_7:481 *Hz*. The normalised REM sleep duration for every individual subject varies between 13:8 to 18:6 minutes/hour. Furthermore, the suspected REM sleep stages for every subject can be determined from accelerometer data.
Conclusion The results of the EEG analysis correspond with the data from literature. Furthermore, the model is capable of detecting suspected multiple REM sleep stages. To compare the EEG results directly with RBD patients and to assess the validity of the model in larger populations including RBD patients, further research is recommended.

Early diagnosis of narcolepsy with the use of EEG by studying the differences in power of the frequency bands

Group 9; Martijn Oude Wolcherink, Suzanne Stouten, Marianne Reintjes

Abstract:
Narcolepsy is a sleep disorder in which patients experience, amongst others, daytime sleepiness and sleep attacks and it is often combined with cataplexy. The onset of narcolepsy is mostly in childhood and young adults (ages 7 to 25), however, diagnosis of narcolepsy takes 5 to 15 years on average, which can have a big impact on the quality of life of these patients. Current diagnosis consists of an overnight polysomnogram, multiple sleep latency tests and occasionally a cerebrospinal fluid test. A quicker and more accurate diagnostic method is desirable. EEG may be a valuable tool for earlier and more accurate diagnosis of narcolepsy. In this research the powers of different frequency bands in the EEG are analysed to study how these powers may differ between a resting state and while performing an auditory task. An increase in the power of lower frequency bands and a decrease in the power of higher frequency bands is expected to be found in narcoleptic patients, due to a lower state of vigilance.