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Assessment and post-treatment evaluation of absence epilepsy seizures

Submission date
08/05/2018

Recruitment status
No longer recruiting

Registration date
10/05/2018

Overall study status
Completed

Last Edited
06/11/2019

Condition category
Nervous System Diseases

[X] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[ ] Record updated in last year

Plain English summary of protocol

Background and study aims
This study investigates whether we can use a headband that has small sensors to measure the electrical activity created from brain activity, to collect information necessary for diagnosing epilepsy and monitoring the effectiveness of anti-epileptic medication. To measure electrical activity, the headband uses a method called electroencephalography (EEG), which is already used for diagnosing epilepsy conditions. However, current NHS EEG methods often rely on in-clinic recordings, with numerous sensors stuck to the head. This study will specifically be investigating the use of a portable version of EEG, smaller than those currently used in the NHS, designed to record EEG information from patients while they are at home. Due to the locations of the electrodes in the system, this system is designed to collect data on patients diagnosed with absence seizures (seizures that cause lapses in awareness, sometimes with staring). The portable EEG system has two main components: the headband and an Android phone with a companion app. The headband is made of flexible material to ensure it is comfortable, adjustable and detachable. The battery should last about 48 hours and is charged easily by removing it from its secure slot on the band and placing it on a wireless charger. A phone will be provided to participants in the study, with the companion app installed on it. The app informs the user that the band is working properly, and helps answer any questions regarding use of the system. It also has a diary which will be used by carers to manually record seizures when/if they occur. In addition to investigating whether this system can record data that could be used for diagnosis, this study aims to look at new ways of automatically highlighting seizure activity in EEG data. This is done with the intention of reducing the time taken to identify these seizures.

Who can participate?
Children aged 3 to 12 suspected of having absence seizures, children referred for a routine EEG but not suspected of having absence seizures, and children who do not have any neurological condition

What does the study involve?
Participants undergo the normal EEG diagnostic procedure, differing only in that both the normal NHS EEG system and the portable EEG system are worn at the same time to allow direct comparison of both systems. The sensors from both systems do not overlap and do not interfere with each other. The number of seizures identified in the clinical EEG and the portable EEG

system are compared. After the routine EEG assessment, participants complete a series of short cognitive tests. Specifically, eye movements are recorded during a task where children are instructed to look quickly and accurately towards or away from a target. Either during or after this eye tracking test, carers complete a questionnaire to rate the child on various behavioural and emotional problems. Patients then complete a task to choose a missing piece in a pattern from a few choices, and a test where they are asked to say the meaning of several words. Patients and carers are questioned on their opinions regarding the portable EEG system. Patients who are diagnosed with any neurological condition are prescribed the appropriate medication by their standard care team. The medication given to patients does not differ from the prescription they would receive if they were not taking part in the study. This is because this study is not investigating the effectiveness of the medications, it is only assessing the ability and reliability of portable EEG to assess patient seizure frequency. All participants are asked to use the portable EEG system during the first weekend after the NHS EEG assessment, when they have yet to receive a diagnosis and are not taking any anti-epileptic medication. This also means patients are not delayed in their access to treatment if they are diagnosed with a neurological condition, as this normally takes over 2 weeks. If a patient is diagnosed with absence seizures, then these patients and carers are asked to continue using the portable EEG system over the course of 6 further weekends. Using methods that attempt to automatically detect seizures in EEG data, along with the seizure tracking diaries the carers are asked to use, seizure frequency is compared before and after medication to see if this method is able to identify a reduction in seizures as medication doses increase into their normal range.

What are the possible benefits and risks of participating?
Although no specific treatment benefits can be guaranteed from participating in this study, involvement in this study is at no cost to participants as they are compensated through reimbursement for car parking fees, travel expenses and a free book of choice. Beyond these immediate benefits, research in general benefits society as it will contribute to assessing whether this system would be beneficial to use with other patients with absence epilepsy in the future. Participation in this study involves minimal risk. This research requires the prolonged use of a portable EEG system, but this is like an already established procedure for collecting information on seizures used by the NHS. However, unlike current NHS procedures, the band can be removed at any time if any discomfort results from its use as it does not use sticky gel.

Where is the study run from?
1. Royal Preston Hospital (UK)
2. Royal Blackburn Hospital (UK)
3. Lancaster University (UK)

When is the study starting and how long is it expected to run for?
October 2016 to September 2019

Who is funding the study?
The Economic and Social Research Council (UK)

Who is the main contact?
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Contact information

Type(s)

Scientific

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Additional identifiers

Protocol serial number
36455

Study information

Scientific Title
Low-density electroencephalography for the assessment and post-treatment evaluation of absence epilepsy seizures

Study objectives
Absence epilepsy is a neurodevelopmental disorder that can develop during childhood or early adolescence and constitutes around 10% of paediatric epilepsy patients (Hughes, 2009). Absence, or petit mal, seizures are characterised by brief, bilateral 3Hz generalised spike-and-slow wave discharges of electrical activity generated from firing neurons, lasting around 9 to 12 seconds (Hughes, 2009). The current main diagnostic method uses Electroencephalography (EEG) in conjunction with video monitoring (Sakkalis, et al., 2013). EEG measures the mean electrical activity measured from electrodes at different sites of the head. Typically, diagnosis will rely on years of training to visually inspect the EEG records. A portable EEG system, comprised of a wearable head band and android app, has been developed to aid the assessment and post-treatment evaluation of absence epilepsy seizures.

The project primarily aims to investigate the utility and data quality of low-density portable EEG, with 'dry' electrodes, and current medical EEG, with 'wet' electrodes, for absence epilepsy seizure detection in the clinic. Secondary aims are to investigate the ability of automatically detecting seizures in both medical and portable EEG, using modern detection algorithms, both on data collected in the clinic and at the patient's home (ambulatory EEG). Other secondary objectives include investigating patient acceptability and patient adherence of active (recording

a seizure diary) and passive (wearing portable EEG) seizure tracking methods, and comparing the cognitive abilities of absence epilepsy patients to controls and pre- and post-medication administration.

Ethics approval required
Old ethics approval format

Ethics approval(s)
HRA and Health and Care Research Wales (HCRW), North West - Preston Research Ethics Committee, 06/03/2018, ref: 18/NW/0070

Primary study design
Interventional

Study design
Non-randomised; Both; Design type: Diagnosis, Device, Imaging, Psychological & Behavioural, Validation of investigation /therapeutic procedures

Study type(s)
Other

Health condition(s) or problem(s) studied
Epilepsy

Interventions
Participants and carers will be instructed on how to use a portable EEG system and seizure tracking diary recorded on an app. Carers will be asked to put a portable EEG headband on the patient on the first Friday evening after the initial consultation and continue use over the course of the weekend. If patients subsequently receive a diagnosis of absence epilepsy from a routine hospital EEG assessment, the patients will be asked to continue to use the system over subsequent weekends for 6 weeks whilst taking their prescribed antiepileptic medication; with the medication being the same that would be prescribed if they were not part of the research. After 6 weeks they will return to do the cognitive tests again and fill in a system questionnaire. If patients do not receive a diagnosis of absence epilepsy, they do not continue use of the headband, instead returning to do the cognitive tests and system questionnaire.

Carers will be asked to complete a questionnaire to assess their use of the headband and the seizure diary. Both open and closed questions are used to ascertain carers thoughts as to the utility of the portable EEG and seizure detection diaries. The responses from these questionnaires will inform future development for the system.

A standardised anti-saccade eye movement task will be used to assess patients' attention. The simple task assesses basic oculomotor and inhibitory control (Antoniades, et al., 2013) and the possible effects of antiepileptic drugs on neurocognitive function (Lo, Shorvon, Luxon, & Bamiou, 2008).

Raven's – Educational: Coloured Progressive Matrices/Standard Progressive Matrices, CPM/SPM are an assessment of nonverbal skills that handle complexity and meaning in confusion by asking participants to choose a missing piece in a pattern from a few choices. The assessment scores can be converted into percentile ranks to estimate their abilities comparative to the normative population as well as into an equivalent age level (Raven, Raven, & Court, 2008).

Crichton Vocabulary Scales (CVS)/Mill Hill Vocabulary Scale (MHV): The CVS/MHV measures skills regarding explicit verbal information that are culturally derived by asking participants to say the meaning of several words.

When the CVS/MHV and CPM/SPM are combined, discrepancies between nonverbal and verbal abilities can be explored. The assessment scores can be converted into percentile ranks to estimate their abilities comparative to the normative population as well as into an equivalent age level (Raven, Raven, & Court, 2008).

Child Behaviour Checklist (CBCL): The CBCL is a caregiver report questionnaire used to rate a child on various behavioral and emotional problems. It is a component of the Achenbach System of Empirically Based Assessment (Achenbach & Rescorla, 2001) and is widely used, with normative data available from multiple societies.

Intervention Type
Device

Primary outcome(s)
Seizure detection: the number of identifiable absence seizures in simultaneously collected low-density portable EEG and clinical EEG during an EEG examination; Timepoint(s): End of Data Collection

Key secondary outcome(s)
1. Automatic seizure detection: the sensitivity, specificity, and false detection rate of automatic seizure detection algorithms on three datasets: EEG data collected in the clinic, NHS 'ambulatory' EEG data collected from the patient's home, and low-density portable EEG data, also collected in the home. Automatic seizure detection algorithms will be compared to carers seizure diaries and clinical physiologist's annotations
2. Patient acceptability: patient feedback on the acceptability of both active (seizure diary) and passive (portable EEG) seizure tracking methods using a developed questionnaire that uses both open and closed questions
3. Patient adherence: patient adherence to using the active (seizure diary) and passive (portable EEG) seizure tracking methods assessed by comparing patient's interactions with the companion app, time spent wearing the portable EEG, and amount of usable data provided from the portable EEG
4. Cognitive assessment: cognitive assessment tasks will be conducted by all participants at baseline and after 2 weeks. Additionally, patients prescribed anti-epileptic medication for absence seizures will do these tasks at 8 weeks after the initial EEG examination. Scores from participants with absence epilepsy will be compared to controls as well as pre-and post-medication.
5. Attention and executive functioning measured by recording the accuracy and error performance on an anti-saccade eye movement task. Eye movements will be compared to controls and pre-and post- medication in absence epilepsy participants
6. Behavioral problems, measured by carer completing a Child Behaviour Checklist (CBCL) appropriate for the age of the child (1 1/2 - 5 or 6-18)
7. Verbal and non-verbal general cognitive abilities assessed using Raven's – Educational: Coloured Progressive Matrices (CPM) or Standard Progressive Matrices (SPM) and Crichton Vocabulary Scales (CVS) or Mill Hill Vocabulary Scale (MHV), given per the age of the participant

Completion date
30/09/2019

Eligibility

Key inclusion criteria
1. Subjects eligible for inclusion in the experimental group for this study are children suspected of having absence seizures between the ages of 3- to 12-years
2. Subjects eligible for inclusion into the clinical control group are patients of a similar age, referred to Preston for a routine EEG, but not suspected of having absence seizures. If a patient is initially included in the experimental group but gets diagnosed with another condition other than absence seizures, they will be placed in the clinical control group
3. A further non-clinical control group, also age matched, will be collected at Lancaster University

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Sex
All

Total final enrolment
2

Key exclusion criteria
1. Confounding medication use:
1.1. Ritalin
1.2. Antidepressants
1.3. Neuroleptic medications
1.4. Anti-epileptics
2. Significant learning difficulties, e.g. autism
3. Neurological conditions, e.g. cerebral palsy
4. The CI may judge a participant unable to take part in the non-clinical control group if they have a diagnosis of any neurological disorders

Date of first enrolment
11/05/2018

Date of final enrolment
30/04/2019

Locations

Countries of recruitment
United Kingdom

England

Study participating centre
Royal Preston Hospital
Sharoe Green Lane North
Fulwood
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PR2 9HT

Study participating centre
Royal Blackburn Hospital
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Sponsor information

Organisation
Lancaster University

ROR
https://ror.org/04f2nsd36

Funder(s)

Funder type
Research council

Funder Name
Economic and Social Research Council

Alternative Name(s)
Social Science Research Council, ESRC, SSRC, UKRI ESRC

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan
The anonymized data generated during the current study will be stored in the UK Data Archive, subject to participant consent. The specifics regarding the access criteria for the data are currently unknown and will be made available later.

IPD sharing plan summary

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
HRA research summary			28/06/2023	No	No