Scan Facts

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FACT SHEET ON THE ELECTROENCEPHALOGRAM (EEG) AND RELATED TECHNIQUES

Lesley Chandra and Stefano Seri,
Department of Clinical Neurophysiology,
Birmingham Children's Hospital NHS Trust.

The electroencephalogram is a method to investigate the electrical activity produced by the brain. Normal brain cells produce electrical fields, which can be recorded from the surface of the scalp, provided a sufficient number of them are functioning together. Children with Tuberous Sclerosis(TSC) might experience seizures, autism and/or cognitive mental difficulties. These are in most cases associated with changes in the brain activity. A variety of techniques can help your doctor understand how the brain is functioning. These can be split into two main groups:

1. The Electroencephalogram (EEG) which records the spontaneous activity of the brain;
2. The Evoked Potentials (EPs), which, by investigating the reactivity of the brain to specific stimuli, can give information on visual, auditory or other sensory functions.

The EEGs

The EEG monitors the activity produced at the surface of the brain. Electrodes (small silver discs) are attached to the head at specific points. The system we use to measure where the electrodes need to be positioned is called the 10-20 System, which is used internationally. To obtain the EEG we compare the activity being produced under one electrode with that of another and plot out the difference between the two. As brain activity is constantly changing, we record the trace over a period of time.

To obtain a clear trace the child needs to be fairly still. To make the procedure more acceptable, in most cases we let the child play with toys such as jigsaws, drawing, reading books or listening to musical toys. The whole procedure is painless, harmless and there is no need to miss any meals before the test. After the test electrodes are removed and the hair cleaned. In spite of the best effort of the technologist, the hair can be a little sticky after and might require a wash at home.

There are several types of EEG recording and the choice of the most appropriate for you or your child will be based on clinical grounds.

Standard EEG

To perform the test, the 11-23 electrodes are attached to the head with a soft paste. Further electrodes can be attached with tape to each shoulder to record the heartbeat (ECG) or to the arms or legs to record muscle activity (surface EMG). In more and more laboratories the acquisition of the EEG can be synchronised with that of a video. This enables a more accurate analysis of possible relationships between changes in behaviour and in the EEG. Brain electrical activity is recorded for 10 to 20 mins, during which time patients will be asked to close their eyes for short periods. Also, depending on age they might be asked to take deep breaths in and out for 3 mins (hyperventilation). To encourage younger children to over breathe, we use windmills or bubbles; hyperventilation causes constriction of the smallest blood vessels in the brain and so puts the brain under a little "stress" which can increase the diagnostic efficacy of the test. At the end of the recording, the child is shown a light that flashes at different rates. This is done to test the reactivity of the brain to the light. In specific and extreme conditions, flickering lights may provoke seizures, but the stimulus can be immediately turned off. The whole investigation lasts about 1 hour.

For babies under 2yrs, we prefer to record the EEG both when they are awake and during sleep. Different activity is seen during sleep and the test is arranged at a time when the baby is likely to be tired e.g. 11:30am or 1:30pm and tend to take 1½-2hrs.

Sleep EEGs

Sleep recordings can be performed at any age, especially if seizures or other changes in normal behaviour occur during the night. They are however a lot more frequently requested in small children since epileptic activity from the brain is more evident during sleep.

For a sleep-deprived recording the parents or guardian are asked to keep the child up 2-3 hrs later and wake them 2-3 hrs earlier than normal. With teenagers, we encourage them to stay up as much of the night before as possible. The appointment is preferably first thing in the morning (9:00-9:45 am). The preparation is similar to that of the standard EEG. We record for 1-1½ hrs, with dimmed lights and quietness to encourage sleep. The entire test usually takes 1½-2hrs.

A natural sleep enhancer called Melatonin can be used to help the patient feel it is time to go to sleep; unlike a drug it does not alter the brain activity. A dose of 2.5-5 mg of Melatonin is given depending on the child's age. Its action is usually within 20-30 minutes and the test lasts 1½-2 hrs.

In a few cases sedation with an oral medicine called Chloral Hydrate is required. This is useful for children who are very active or unable to co-operate, although a standard recording will usually be attempted first. In most hospital environments, the child will be booked into a Medical Day Unit (MDU) first, where the sedation will be given. When the child is sleepy they are brought to the department to settle into sleep. The electrodes are placed once the child is asleep. After removal of the electrodes the child would go back to the MDU for the nurses to check that the child is fit to go home.

Ambulatory EEGs

This is a specialised test and should be requested when information is needed on the distribution during the day of epileptic attack or to quantify epileptiform EEG activity during the day. It does not replace standard and/or sleep recordings but must be considered as a complementary procedure. Ambulatory EEGs are particularly useful for patients who are having several seizures or episodes during the week.

A number of electrodes ranging from 9 to 14 are attached with paste and glue, as they will remain on the head for 1 to 4 days. The EEG is recorded onto a computer card in a portable recorder about the size of a personal cassette player. The child will need to return each day to have the electrodes checked and to have the card and battery changed. At the end of the recording, the electrodes are removed with Acetone (similar to nail varnish remover) and the hair combed to thoroughly remove the glue. It may however take several washes and combing through at home to remove the remnants. Set-up and removal days take about an hour each and $^1/_2$ hr for each check.

Video Telemetry

In patients with seizures that prove to be refractory to at least two major anti-epileptic medications, surgical removal of the area where the seizures start can be considered. In these cases, a major part of the diagnostic work-up will involve video telemetry. The purpose of the test is to try and record at least three seizures on video as well as recording the EEG. Localising the site of origin of the attacks is the specific aim of the procedure; therefore many more electrodes than a standard EEG are required. This requires that the child be admitted to a dedicated ward for a week. Medication is usually reduced over the first day to facilitate the occurrence of epileptic attacks and the child may be deprived of sleep if no seizures are recorded after three days.

Set up can take up to $1^1/_2$ hours. The EEG activity and a video recording are transmitted from the ward to the department and stored on digital media. Examining the EEG and video at the time of a seizure enables the specialists to identify its origin in the brain. This is used as one of the main criteria in deciding whether surgery is a viable option or to plan possible further more invasive monitoring.

Evoked Potentials (EPs)

EPs are used to assess how well single sensory pathways are working. Each investigation takes between 1-1½ hrs. Like EEGs these tests are harmless, painless and no fasting is required beforehand. The response is usually of very small amplitude with respect to the rest of brain electrical activity, requiring several samples to be taken before the response can be clearly identified.

VEP - Visual Evoked Potential

This test measures how information entering the eye reaches specific areas of the brain to be processed. Three to five electrodes are attached to the back of the head (this is where information from the eyes is processed). In some cases two more electrodes are used to pick up the activity of the first neural structures in the eye (the retina); this test is called electroretinogram (ERG). The pathway is stimulated using either a flashing light, or by reversing black and white squares. The child is asked to look at the light or screen and approximately 100 samples are taken.

BSEP - Brainstem Evoked Potential

In this investigation the auditory pathway is stimulated, beginning with neural structures within the ear (cochlea) and the auditory nerve.

Electrodes are attached at the top of the head and behind each ear. A series of sound clicks delivered through earphones are used as stimuli and the brain response in the 10 ms following the stimulus is recorded. Several waves are seen as the response passes through the brainstem (the part of the brain that controls reflex action such as breathing) and into the brain. This is a very sensitive test and requires complete stillness so oral sedation such as chloral hydrate is often given, especially in younger children.

SSEPs - Somatosensory Evoked Potential

These EPs are recorded by stimulating the sensory component of a nerve in the arm or leg. Electrodes are attached to the head, neck and shoulders/back and a small electrical stimulus is used to stimulate the nerve directly, producing a small twitch. This can result in a strange sensation which some people dislike, but it is not painful. Approx. 250 good responses are averaged and the waveforms measured. They reflect the transit of the information through the spinal cord, the lower part of the brain, and the area of the brain involved in processing sensory stimuli.

We don't think we have covered the entirety of the procedures available to investigate electrical brain functioning. We see this fact sheet as a help to families and individuals with TSC to be informed about the most frequently performed procedures. Ideally it will enable you to discuss the tests and their results with your doctor and to play a more active role in the management of the possible neurological symptoms of TSC.

Mrs Lesley Chandra,
Head of Neurophysiology,
Birmingham Children's Hospital NHS Trust (EPTA)

Dr. Stefano Seri
Director, Paediatric Neuroscience Programme
and Department of Clinical Neurophysiology
The Birmingham Children's Hospital NHS Trust
Hon Senior Lecturer, University of Birmingham
Hon Prof. Developmental Neuropsychiatry,
University "Tor Vergata", Rome, Italy

E-mail: neurophysiology.department@bhamchildrens.wmids.nhs.uk

*Further information on TS and the work of the TSA can be obtained from: Diane Sanson, Head of Administration, PO Box 12979, Barnt Green, Birmingham, B45 5AN .
Tel/Fax: 0121 445 6970
Email: diane.sanson@tuberous-sclerosis.org*

Tuberous Sclerosis Association

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