

# Electrophysiological methods in clinical diagnostics

## Introduction

The methods used in the clinical diagnosis of CNS disorders can be divided into *two groups*:

### Subjective

- for example, tests, rulers for measuring pain, etc. The disadvantage of the method is the possibility of simulation or disimulation and the fact that it cannot be applied to patients who are reluctant or unable to cooperate.

### Objective

- EEG (electroencephalography)
- Evoked potentials
- Unit neuronal activity

## EEG

Electroencephalography is a *non-invasive method used to record brain activity*. The electrical potentials of the neurons are measured using external electrodes. We then describe several types of waves on the electroencephalogram - we evaluate **the frequency and amplitude of the waves**. In general, the amplitude of the waves decreases with increasing frequency. EEG also changes with age - the frequency of waves gradually increases from childhood, in adulthood,  $\alpha$  activity stabilizes, but factors such as *hypoglycemia or lowering temperature can reduce it*.

### Activity types

- **$\alpha$  activity** -  $f = 8-13$  Hz, in unfocused people, in complete calm with closed eyes (so-called relaxed vigilance)
- **$\beta$  activity** -  $f = 14-30$  Hz with low amplitude, physiologically  $\alpha$  activity changes into  $\beta$  activity in people with emotional or sensory stimulation, this phenomenon is called **desynchronization**. The change also occurs when the eyes are opened - the so-called  **$\alpha$  blockade**.
- **$\delta$  activity** -  $f = 0.5-3.5$  Hz, physiologically only in deep sleep
- **$\theta$  activity** -  $f = 4-8$  Hz, physiologically in young children, in adults only in sleep
- **$\gamma$  activity** -  $f = 30-60$  Hz

Electroencephalography is now used mainly for the *diagnosis of epilepsy* (spiked wave recording) and *sleep disorders*. Other uses include **the diagnosis of brain death**, which is defined on the EEG by an isoelectric line lasting at least 20 minutes and the inability to evoke evoked potential.

## Evoked potentials

**Certain nuclei and areas of the brain** can be stimulated with electrodes placed in different places on the head. EPSP (excitatory postsynaptic potential) then develops in such stimulated areas. The device then measures **the latency between pacing and response** (potential generation). The method of evoked potentials is used in the diagnosis of sensory disorders in patients who cannot, do not want or are not able to cooperate in other examination methods (eg comatose patients, mentally retarded, children ...). We recognize several types of examinations:

- **ERA (evoked response audiometry)** - activation of the auditory pathway and auditory nuclei, physiologically latency *50-350 ms*.
- **VER (visual evoked responses)** - light stimulation, for diagnostics of visual tract disorders, latency *50-350 ms*.
- **SER (somatosensory evoked responses)** - stimulation of peripheral nerves, latency *50-350 ms*.
- **BEAR (brain-stem evoked auditory responses)** - gradual response of all parts of the auditory pathway, latency up to *10 ms*. This method is used to diagnose hearing problems and multiple sclerosis.

*You can find more detailed information on the evoked potentials page.*

## Unit neuronal activity

This method makes it possible to measure **the activity of individual neurons**. The activity is sensed either intracellularly - by glass or metal microelectrodes, or extracellularly. It is used rather experimentally because it is expensive and demanding. Thanks to the sensing of unit activity, it was possible to find out that in specific nuclei there are cells responding to other than the primary modality of the nucleus (cells responding to light, etc. were found in the cells of the auditory nuclei).

# Links

## Related articles

- EEG
- Epilepsy
- Evoked potentials
- Sleep

## References

- GANONG, William F, et al. *Overview of medical physiology*. 1st edition. Jinočany: H & H, 1995. 681 pp. ISBN 80-85787-36-9.
- ROKYTA, Richard, et al. *Physiology for bachelor studies in medicine, natural sciences and sports*. 1st edition. Prague: ISV, 2000. 359 pp. ISBN 80-85866-45-5.