VISUAL EVOKED POTENTIAL

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Evoked Potentials Studies

- (Evoked Brain Potentials, Evoked Responses, Visual Evoked Response [VER], Brainstem Auditory Evoked Response [ABER], Somatosensory Evoked Response [SER])
Evoked potentials studies measure electrical activity in the brain in response to stimulation of sight, sound, or touch. Stimuli delivered to the brain through each of these senses evoke minute electrical signals. These signals travel along the nerves and through the spinal cord to specific regions of the brain and are picked up by electrodes, amplified, and displayed for a physician to interpret.
visual evoked response (VER) test

- Can diagnose problems with the optic nerves that affect sight. Electrodes are placed along the scalp. The patient is asked to watch a checkerboard pattern flash for several minutes on a screen, and the electrical responses in the brain are recorded.
Visual Evoked Potential Test (VEP)

- It is similar to an electroencephalogram (EEG) in that it records brain waves. It differs in that it focuses specifically on the parts of the brain that involve vision. Since the visual nerves run the entire length of the head, this test can evaluate a large part of the brain.
Basic Technology

1. Stimulus parameters
   A. Pattern stimulus
      i. Pattern reversal stimulus
      ii. Pattern onset/offset stimulus
   B. Flash stimulus

2. Electrodes
   A. Electrode Placement

3. Recording parameters
   A. Amplification (20,000–50,000 times) and averaging systems
   B. Analysis time
Technique

- Pattern reversal is the preferred technique for most clinical purposes. The results of pattern reversal stimuli are less variable in waveform and timing than the results elicited by other stimuli. The pattern onset/offset technique can be useful in the detection of malingering and in patients with nystagmus, and the flash VEP is particularly useful when optical factors or poor cooperation make the use of pattern stimulation inappropriate.
Figure 2. A normal pattern reversal VEP.

Figure 3. A normal pattern onset/offset VEP. Note that with a 300 ms sweep only the pattern onset response is recorded.

Figure 4. A normal flash VEP.
Normal values

- Even though standardization should ensure similar responses across laboratories, each laboratory must establish its own normative values using its own stimulus and recording parameters.
- A minimum of two recordings of each VEP condition should be acquired, measured and displayed.
Pediatric VEP recording

Multi-channel recording for assessment of the central visual pathways

Some specialized types of VEP not covered by the ISCEV standard

- Steady state VEP
- Sweep VEP
- Motion VEP
- Chromatic (Color) VEP
- Binocular (dichoptic) VEP
- Stereo-elicited VEP
- Multi-channel VEP
- Hemi-field VEP
- Multifocal VEP
- Multi-frequency VEP
- LED Goggle VEP
Clinical usefulness of VEPs includes the following:

- More sensitive than MRI or physical examination in prechiasmatic lesions
- Objective and reproducible test for optic nerve function
- Abnormality persists over long periods of time
- Inexpensive as compared with MRI
- Under certain circumstances, may be helpful to positively establish optic nerve function in patients with subjective complaint of visual loss; normal VEP excludes significant optic nerve disorder
Optic neuritis versus ischemic optic neuropathy
- Atilla et al found that VEP amplitude decrease was more significant in ischemic optic neuropathy, while optic neuritis showed more significant latency prolongation.

VEP in adrenoleukodystrophy
- Adrenoleukodystrophy is an X-linked metabolic disorder with very long-chain fatty acid (VLCFA) accumulation and multifocal nervous system demyelination, often with early involvement of visual pathways. Kaplan et al found that pattern-reversal VEPs were abnormal in 17% of the men with adrenoleukodystrophy; no evidence indicated that reduction of VLCFA levels improved or retarded visual pathway demyelination.

Optic neuropathy due to HTLV-1
- Yukawa et al found delayed P100 latencies in 7 of 46 eyes in patients with uveitis due to the virus.

Pattern-reversal VEP in classic and common migraine
- in patients with classic migraine, P100 amplitude was significantly higher than in healthy subjects, whereas latencies of pattern-reversal VEPs did not differ significantly. These results suggest that patients with classic migraine may have hyperexcitability in the visual pathway during interictal periods and that the increased amplitude of pattern-reversal VEPs after attacks may be due to cortical spreading depression.

Szabela et al found abnormal VEP in 22% of type 2 diabetics.
The SVEP is used to measure visual acuity, this is, vision for detail and patterns. In adults, visual acuity is measured with lines of letters. The SVEP measures acuity by assessing the response of brain waves to moving black and white stripes. The SVEP acuity test is, perhaps, most helpful in those youngsters for whom behavioral measures (Preferential Looking) give ambiguous or incomplete information about visual acuity.

To do this test, your child will be positioned to view a TV. On the TV will be shown moving ("sweeping") black and white stripes. Your child may sit on your lap or in a chair.

The idea of the test is that the vision for the stripes is passed from the eye, along the visual pathways, to the visual part of the brain. The procedure is designed to find the finest black and white stripes that produce a reliable response.
Flash visual evoked potential monitoring of optic tract function during macroelectrode-based pallidotomy (Department of Neurological Surgery, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania)
Visual evoked potential: a diagnostic tool for the assessment of hepatic encephalopathy.

M L Zeneroli, G Pinelli, G Gollini, A Penne, E Messori, G Zani, E Ventura

Visual evoked potential recordings were examined in 45 liver cirrhosis patients with (n = 29) and without (n = 16) encephalopathy, in 15 normal volunteers, and in one patient with an opioid induced stupor state. Visual evoked potential parameters were classified on the basis of EEG recordings. Plasma concentrations of amino acids, octopamine, and ammonia were assayed in order to document the metabolic change of hepatic encephalopathy. Latencies and wave patterns recorded after flash stimulation differentiated the four degrees of the coma one from another according to EEG classification in the 29 patients with encephalopathy. In the group of 16 patients without clinical and EEG evidence of encephalopathy the visual potential recordings discriminated a group of patients (n = 10) in a preclinical stage of encephalopathy. Biochemical parameters and subsequent clinical observation of patients confirmed our judgement of a preclinical stage of encephalopathy. These results suggest that visual evoked potentials are a simple, suitable and objective method for differentiating the degrees of encephalopathy and for identifying the preclinical stage of encephalopathy.
With abnormal VEP, some of the differential diagnostic considerations are as follows:

- Optic neuropathy
- Optic neuritis
- Ocular hypertension
- Glaucoma
- Diabetes
- Toxic amblyopia
- Leber hereditary optic neuropathy
- Aluminum neurotoxicity
- Manganese intoxication
- Retrobulbar neuritis
- Ischemic optic neuropathy
- Multiple sclerosis
- Tumors compressing the optic nerve - Optic nerve gliomas, meningiomas, craniopharyngiomas, giant aneurysms, and pituitary tumors

**Normal VEP virtually excludes an optic nerve or anterior chiasmatic lesion.**
Summary

- The VEP is preferable in optic nerve and anterior chiasmatic lesions, while MRI is clearly superior in retrochiasmatic disease. Note that the VEP is nonspecific as to the underlying etiology and pathology.