The Organization of the Retina and Visual System

Visually Evoked Potentials

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Introduction

The terms visually evoked potential (VEP), visually evoked response (VER) and visually evoked cortical potential (VECP) are equivalent. They refer to electrical potentials, initiated by brief visual stimuli, which are recorded from the scalp overlying visual cortex, VEP waveforms are extracted from the electro-encephalogram (EEG) by signal averaging. VEPs are used primarily to measure the functional integrity of the visual pathways from retina via the optic nerves to the visual cortex of the brain. VEPs better quantify functional integrity of the optic pathways than scanning techniques such as magnetic resonance imaging (MRI).

Any abnormality that affects the visual pathways or visual cortex in the brain can affect the VEP. Examples are cortical blindness due to meningitis or anoxia, optic neuritis as a consequence of demyelination, optic atrophy, stroke, and compression of the optic pathways by tumors, amblyopia, and neurofibromatosis. In general, myelin plaques common in multiple sclerosis slow the speed of VEP wave peaks. Compression of the optic pathways such as from hydrocephalus or a tumor also reduces amplitude of wave peaks.

This review covers a brief history of visual evoked potentials, the most commonly used stimuli to initiate visual evoked potentials, the methods of recording, the sources of visual potentials, the effects of maturation and acuity, and sample patients.

History

VEPs initiated by strobe flash were noticed in the early years of clinical encephalography (EEG) in the 1930s. A VEP can often be seen in the background EEG recorded from the occipital scalp following a flash of light (Figure 1). Evoked potentials, whether auditory, visual or somatosensory, are extracted from the EEG by a simple program. This technique of extracting a signal from random noise is one of the oldest applications of computer technology. This process is similar to programs used to extract radar signals from jamming nearly 70 years ago. Adding the electrical activity for set time periods is called "signal averaging". Dawson first demonstrated a signal-averaging device in 1951 and signal-averaging computers have been available since the early 1960s. The computer programs save a defined time period of EEG activity following a visual stimulus, which is repeated over and over adding the signals together. The random EEG activity averages away, leaving the visually evoked potential. Depending on the signal to noise ratio, an evoked potential can be seen forming following only a few stimuli such as flashes of light.